THE X-RAY EXAMINATION

OF THE HEART WITH SPECIAL REFERENCE

TO THE CARDIAC AREA IN DISEASE

By

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This investigation of over one hundred cases of cardiac conditions was carried out in the Radiological Department of the Royal Infirmary, Edinburgh, and was only rendered possible by the encouragement, advice and facility generously given to me by Dr. J.M. Woodburn Morison to whom I am deeply indebted.

Practically all the cases concerned were sent for examination by Prof. D.Murray Lyon and Dr. A. Rae Gilchrist of the Royal Infirmary, Edinburgh and I am very grateful to them for rendering the clinical aspect of these cases to supplement the investigation.

SUMMARY OF CONTENTS.

It is but little more than a century ago that the physician was without any practical means of examining the heart of his patient, apart from studying the general condition which the patient presented and from palpating his arteries.

From such conclusions as he might draw by this examination, he endeavoured to reach a diagnosis of the state of the heart, and it can readily be imagined how great must need his endeavour have been, and how limited his scope for accurate diagnosis. It was not until about 1806 that Corvisart studied, perfected and introduced the art of percussion. This was perhaps the first method of precision adopted for the examination of the heart, and the stimulus it created for further investigation was no doubt responsible for the rapid succession with which other methods of precision in examination appeared.

To Laënnec we owe the application of auscultation, to Marey, the sphygmograph, to von Basch and Potain sphygmomanometry, these latter along with Vierordt and Riva-Rocci perfecting manometry. For the electrocardiograph we are indebted to Matteuci, Waller and Einthoven, and finally/

finally again to Potain for radioscopy who is credited with establishing one of the first radiological laboratories in Paris within a very short period after the discovery of X-rays. To such an ardent cardiologist as Potain, ever anxious to utilise all the available advances in clinical investigation, the radiological examination of the heart appealed in no small manner. In those early days the X-rays were believed incapable of giving little more than a rather untrustworthy view of the general size and shape of the heart. The first radiogram of the heart is reported in the Archives of the Roentgen Ray to have been taken by John McIntyre of Glasgow. Since that time, with improvement in technique and apparatus, a vast amount of work has been carried out in the investigation of the heart by X-rays. Elaborate special apparatus has been designed and utilised, until, at the present time, there is little which the radiologist cannot either perceive in regard to the heart, or base accurate calculations upon. It is therefore rather to be commented upon that, in most of our modern text-books on general medicine, little or no reference is made to the utility of radiology in the examination of the heart. Further, in text-books dealing more particularly with diseases of the heart, though a chapter may be devoted to the methods employed in the radiological examination of the heart, it is not stated with any degree/

degree of assuredness whether such examination is necessary or at least helpful aid to diagnosis. Such omission to attach any importance to the radiological evidence in the investigation of diseases of the heart may be, in part, due to the use by the clinician of his already extensive and accurate armamentaria for examination, which, providing him with as much information as he may desire, leaves little or no field for the radiologist. On the other hand it may be due to the belief that such radiological examination is not thoroughly standardised; that it takes too much time and investigation by a skilled radiologist; that it demonstrates only the grossest pathological conditions and finally that it is of little practical significance. It is the aim and purport of this contribution to demonstrate that, firstly, a simple standard method of the examination of the heart with the use of X-rays can be easily adopted, that the interpretation of the radiographic film can be carried out simply and with little difficulty and that finally the conclusions which may be drawn from the X-ray appearances and measurements, form, on the lowest estimate, at least a valuable support to the diagnosis.

In the hands of a skilled cardiologist the position, the general contour and the size of the heart can in certain cases be approximately and even accurately recorded, but it must be remembered/

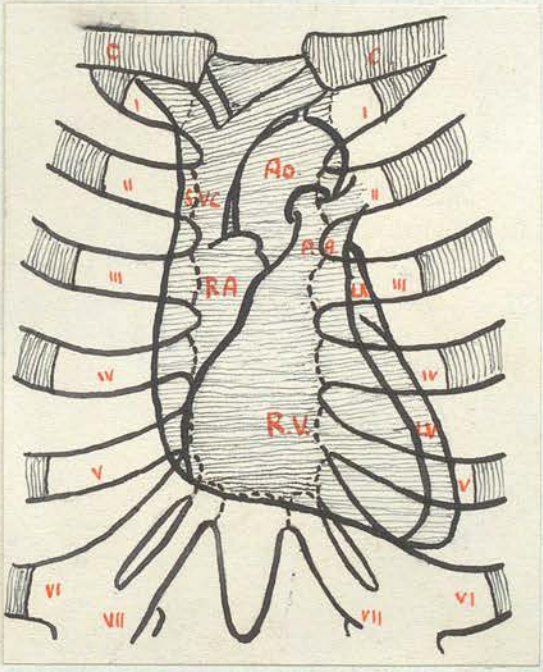
remembered that this can only be applied to the borders of the heart which are available for percussion, and that any such estimate is only reached by the employment of a more or less indirect method. The conclusions which can de drawn from such examination can therefore only be taken as presumptive evidence.

If the left border of the heart is percussed and found to be somewhat further to the left than what is normal for the individual it may be presumed that the heart is enlarged, either by hypertrophy or dilatation; but with the difficulty experienced in many cases of percussing the right border of the heart it is not justifiable to presume an enlargement when the condition may be mere displacement of the heart.

Radiological evidence gives direct evidence. It is based on physical laws which cannot err, and when a rational technique is adopted, and a method of precision employed, can give to the clinician direct irrefutable evidence of the position, size and form of the heart and main vessels.
If for example, we compare the anatomical landmarks of the heart as obtained by percussion and by radiography, with those of the anatomist, we cannot fail to observe on the one hand how necessarily accurately do the radiological and anatomical landmarks conform to one another, and on the other hand how unlike the true cardiac outline is the projection/

jection obtained by percussion alone.

The first diagram gives us the anatomical surface marking of the heart in relation to the anterior thoracic wall.



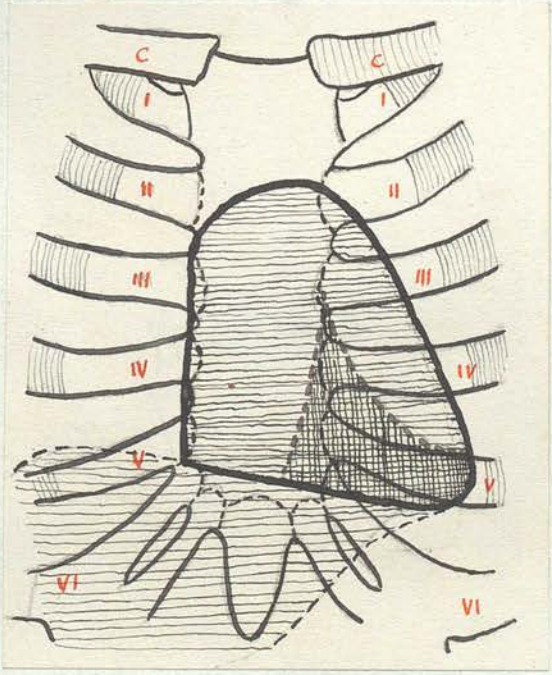
Here we see the complete heart outline and the outlines of the great vessels. The drawing showing those portions of the heart which go to make up the borders as seen on a surface projection.

The second diagram is a drawing of the projection of the heart on the anterior thoracic wall as produced by an orthodiagram. The outlines/

outlines which are generally shown quite clearly are those of the aortic bulb, the pulmonary arch, the left auricle and ventricle and the right auricle. Less clearly shown and indicated by dotted lines are the outlines of the innominate vessels on the left side, a small portion of the descending aorta, the superior vena cava on the right side and the upper right lateral border of the ascending arch of the aorta. The lower border of the heart is usually, except on deep inspiration, unfortunately obscured by the liver and diaphragm shadows.

The third diagram shows the usually accepted/

accepted outline of the heart as obtained by superficial and deep percussion of the organ. The object of such percussion is to outline the area of the heart's dulness which corresponds to the projection of the heart on the anterior wall of the thorax, but it is observed that percussion does not give an outline so clearly comparable to the anatomical outline as that obtained by radiography.



It is also doubtful whether any reliance can be placed on percussion over the sternum owing to the fact that the note produced there is representative of the structures underlying it as a whole.

A great deal of controversy has arisen over/

over the question of the percussion of the right border of the heart. The right auricle, not having the muscular development of the left ventricle, is relatively more difficult to percuss, and on this account authorities cannot agree as to whether or not the right auricle is percussable in normal states of the heart.

Potain states that the right border of the right auricle corresponds with the right border of the sternum, other writers state that it lies behind the sternum. Vaquez and Laidlaw, writing on this subject, go so far as to state that, "at all events any extension of the auricle beyond the right border of the sternum indicates a pathological condition consisting in a dilatation of the right heart especially of the auricle".

In Cowan and Ritchie's Diseases of the Heart these writers state that "the area of cardiac dulness under normal circumstances is an inaccurate guide to the size of the heart, for, though the left and upper margins can be delimited fairly accurately the right margin is always within the right border of the sternum -------- and the so-called areas of superficial and deep dulness are notoriously inaccurate".

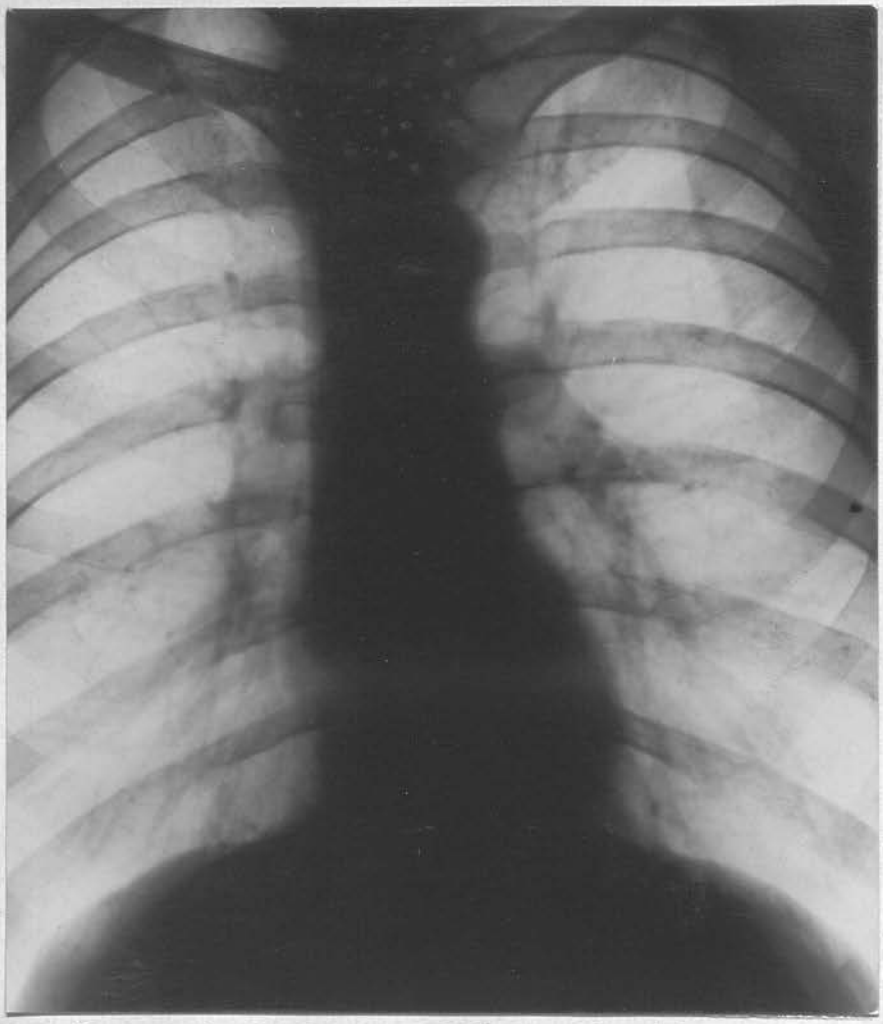
Further we must consider the fact that the heart is an organ in continual motion during the examination and that even in suspended respiration its borders move an appreciable distance. Dietlen/

Dietlen has demonstrated that this movement by pulsation may vary in the normal heart from 2 to 7 millimeters the smaller figures however, being still in doubt. It is, nevertheless, certain that differences occur in the normal pulsation that are conditioned by the frequency of the pulse, the duration of diastole, and also by the type of pulsation and the form of the heart generally.

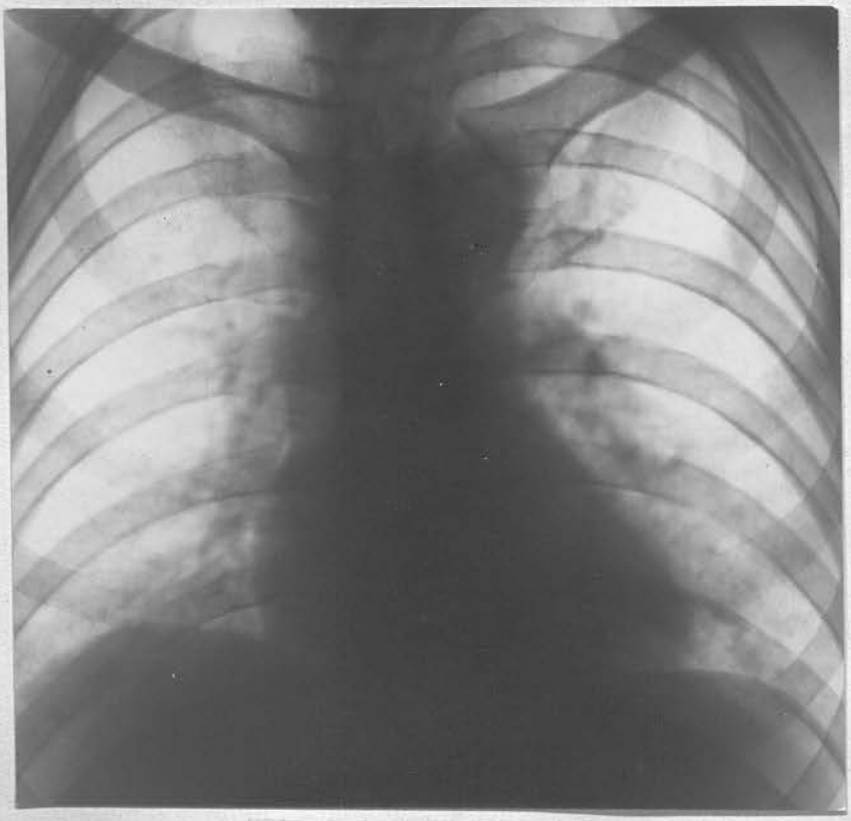
In the pathological heart the greatest excursions are seen in exophthalmic goitre, extreme bradycardia and dilated left ventricle consequent upon aortic insufficiency. In these conditions excursions by pulsation are recorded of from 7 to 20 millimeters. It is also of importance to note that both in the normal and diseased heart the greatest pulsation is seen in maximal inspiration and conversely the least pulsation in maximal expiration.

The respiratory movements, furthermore, result in a much more pronounced alteration in the shape and position of the heart, and unless the same patient were percussed at the same period of the respiratory phase at each examination no accurate estimate could be made of at least the smaller degrees of alteration in the size of the heart.

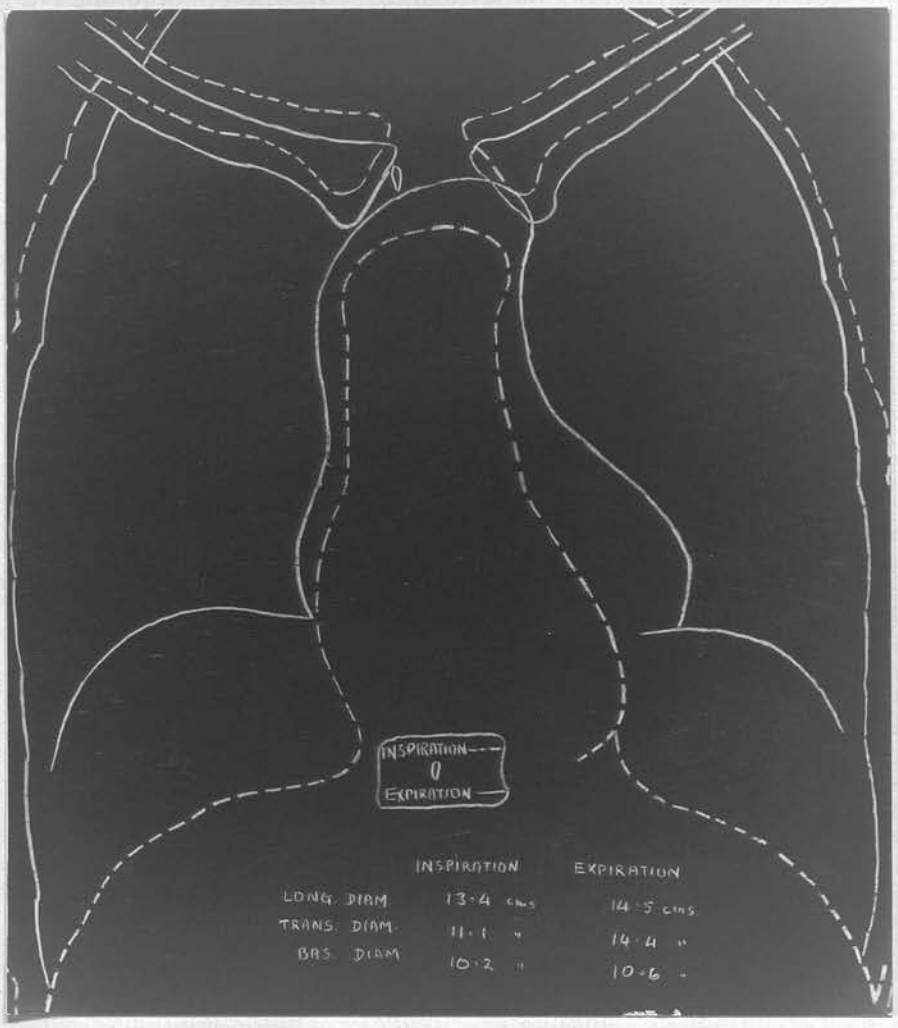
In order to show how markedly respiration can alter the shape of the heart, a normal healthy male adult was radiographed during forceful respiration/



Radiograph No.1. Full Inspiration.



Radiograph No. 2. Full Expiration.



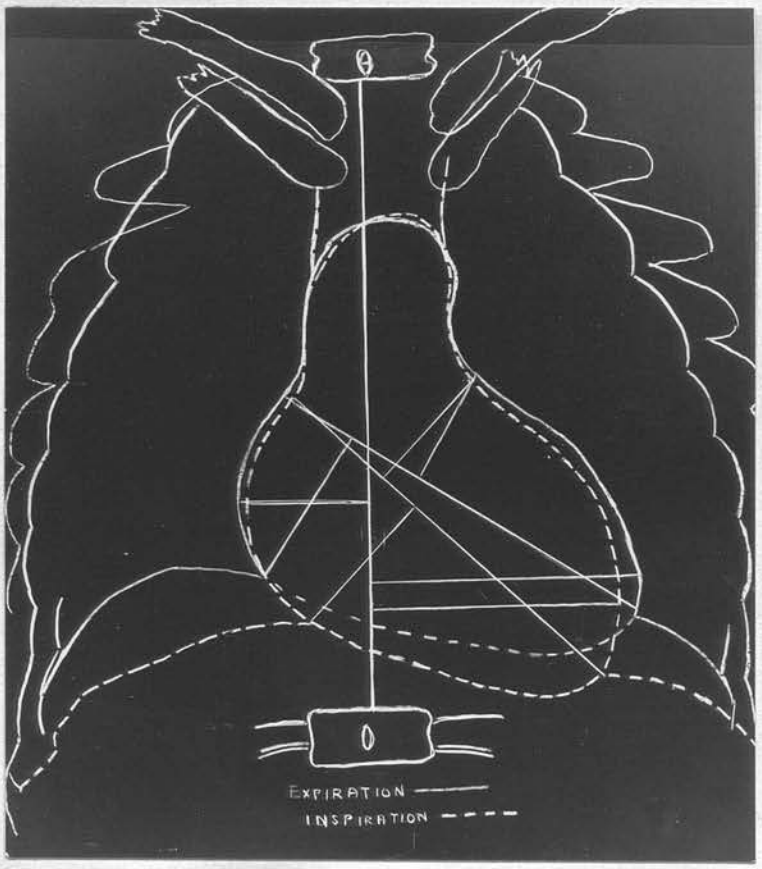
Superimposed Tracings of Radiographs 1 & 2.

Radiograph No. 1 shows the appearance of the normal heart during maximal inspiration.

Radiograph No. 2 was taken on maximal expiration and even from the radiographs the marked alteration in shape can be observed. Tracings were then made from both of the radiographs, superimposition being secured by marking off on each tracing two of the dorsal vertebrae in each case. These tracings were then superimposed and they give the graphic result as seen in the semidiagram above. The tracing on Inspiration is shown by the dotted line, that on Expiration by/

by the continuous line. The transverse, longitudinal and basal diameters were then measured. It is shown that the longitudinal diameter is increased on expiration by 2.1 cms. the transverse diameter, which is perhaps the most important diameter, by 3.3 cms. and the basal diameter by .4 cms, in this case.

These rather gross variations are of course due to the forced respiration employed to demonstrate this point, but even in normal quiet respiration the differences are quite sufficiently self-evident.



The above print of two superimposed tracings taken of a casual patient during very quiet respiration/

respiration shows the minimal amount of alteration of the heart shadow. Here on expiration the longitudinal diameter is increased by .3 cms. the transverse by 1 cm. the basal diameter remaining almost unaltered.

Again marked alterations in the position and shape of the heart occur with alteration of the position of the patient, which must be taken into account when estimating by percussion or otherwise the size of the heart. In the erect position by leaning to one or other side the heart may shift from 1 to 2 cms. from the median line. In the erect posture the heart depends more from the vessels and the basal insertions, while in the lying down position it spreads out, so to speak, as if pushed upwards from below.

Respiration also shows a difference in its effect on the position of the heart according to the posture of the patient. In decubitus forced inspiration lowers the diaphragms and heart considerably below the mean position of quiet respiration, while in the erect position it is forced expiration which produces the greatest variation from the mean position.

Electrocardiograms of the heart have in many cases presented interesting and in some cases confusing anomalies for the explanation of which several theories have been advanced. Variations in electrocardiographic curves with alteration in the position of the same patient while using the same leads appeared to be only explainable by an alteration in the position of the heart.

This was studied carefully by Hering and was what led Waller to advance his axial hypothesis which explained the variations that were produced according to whether the heart lay in a more or less vertical, or a more or less horizontal position in the thorax. The anatomical and electrical axes of the heart approximate closely enough to support the hypothesis. This demonstrates the importance of obtaining the anatomical axis of the heart which can undoubtedly be best obtained radiologically. Vaquez and Laidlaw further are of opinion that to make the axial hypothesis of Waller impregnable ventricular mass must be taken into account.

If this is so ventricular mass can be readily estimated from calculations of the surface area of the heart as obtained by X-ray projection, the only apparent difficulty that arises being the differentiation between a dilated and a hypertrophied heart.

Such/

Such differences however both from the clinical evidence and the radiological appearances are generally ascertainable.

Electrocardiography has been stated by some writers to be of little value in the diagnosis of valvular lesions of the heart, there being often no characteristic differences shown between curves of aortic or mitral insufficiency.

It is stated by Pardee that electrocardiographic curves by showing a relative increase in size of one or other chamber of the heart may assist in the diagnosis of valvular lesions, but that, as he points out, in this respect electrocardiography falls far behind radiological examination. In conditions associated with adherent pericarditis where the radiographic examination is usually characteristic, normal electrocardiographic curves may be recorded.

In the diagnosis of functional and organic valvular diseases of the heart it was hoped that radiology would be of assistance, but, contrary to expectation, writers on this subject state that radiology gives aid only by chance, and that any visible change that may be seen is only a late manifestation. In the early stages changes are too slight to be of importance in aiding the diagnosis. It is hoped to be shown however that in the cases studied by the writer changes even of slight degree are apparent and are of definite significance/

significance. If functional murmurs of the cardiopulmonary type however are, as Potain taught, dependent upon the size of the heart and the type of pulsation, then radiographic estimation of the area of the heart will prove of some value in their explanation, These murmurs have been shown to be less frequent in large hearts and more frequent in the dropped hearts of chlorosis and tuberculosis.

Radiology is thus shown to be of greater value in estimating the position, size and shape of the heart than even the most accurate percussion; that with it valuable aid may be given to the determination of variations in electrocardiographs, by showing the anatomical axis of the heart, and the relative dimensions of the various chambers, and that in certain cases the determination of functional heart murmurs can receive considerable assistance.

The methods that are used in the radiological examination of the heart will now be considered.

RADIOSCOPY.

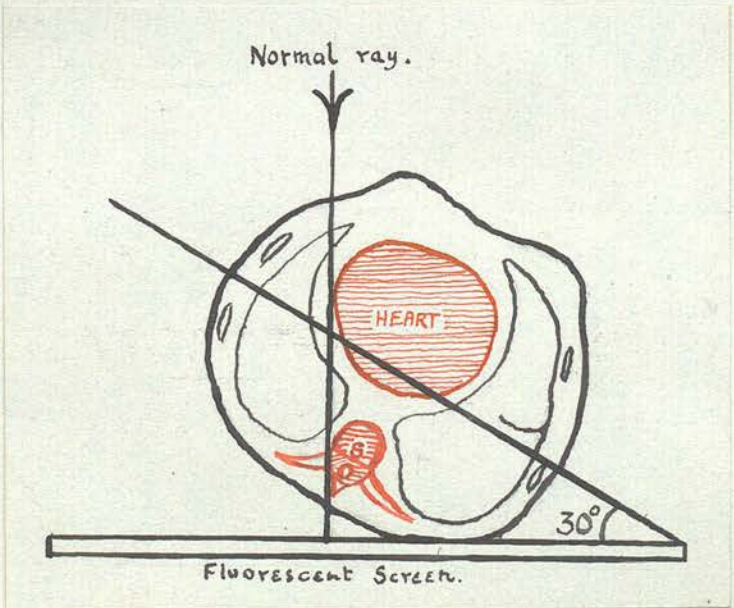
By means of the fluorescent screen a general view of the thorax is obtained. Owing to the divergence of the rays at the short focal distance usually employed, marked enlargement of the object is produced on the screen, which must always be allowed for. The presence of gross cardiac conditions can be detected, aneurysmal dilatation of the aorta or any concomitant mediastinal, pulmonary or diaphragmatic abnormality recorded.

In some cases it may be of significance to observe the type of pulsation of the heart. A weak action-type of pulsation is seen most commonly in enlarged hearts and particularly in conditions of insufficiency from chronic myocarditis. A powerful action-type is observed in hypertrophic conditions, in patients with contracted kidneys and most noticeably in conditions of aortic insufficiency. In pericarditis there may be little or no visible pulsation.

The patient can also be examined in the various oblique diameters and from such angles information can be obtained of localised enlargements of the heart shadow. It is usually only in an oblique view that direct evidence of enlargement of/

of the right ventricle can be derived.

A method of estimating an increase posteriorly of the left ventricle has been introduced by Vaquez and Bordet. This is the angle of disappearance of the left ventricle at the left lateral border of the vertebral column when viewed in the right posterior oblique position. The patient is placed with his back to the fluorescent screen and rotated to his right side. During this rotation the shadow of the left ventricle passes to the right and that of the vertebral border to the left. When the most lateral border of the ventricle just coincides with the vertebral column the angle which the patient then makes with the fluorescent screen is recorded either by the use of a rotating turntable marked off in degrees or by the use of a goniometer. These investigators state that when this angle is greater than 25 to 30 degrees the left ventricle is enlarged posteriorly.

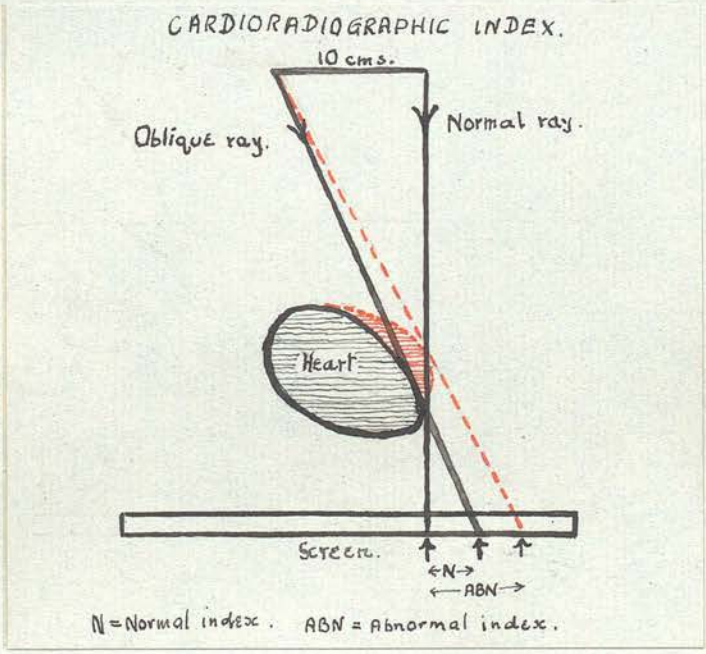


The writer has used this method in most of the cases examined and concludes that it is of little value since several factors are introduced which render comparative estimations inaccurate. Owing to the large amount of focal aberration obtaining at a short focal distance it is essential that the distance of the heart wall from the vertebral column should correspond in different patients. The depth of the chest however varies considerably in different individuals, also the posture adopted by the patient, some tending to stoop, others to stand erect. These factors produce differences in distance between the heart and the vertebral column and thereby introduce considerable errors into this estimation.

A much more accurate method of estimating posterior enlargement of the heart is that of determining, what has been called by Morrison and White, the Cardioradiographic Index.

The method was devised by Vaquez and Bordet, and consists in directing a narrow vertical slit of rays on the screen tangential to the left border of the heart. A mark is then put on the screen corresponding to this border. While the patient is kept as motionless as possible the X-ray tube is then shifted to the patient's right side a distance of 10 cms. and the diaphragms opened up. The rays are now passing obliquely across the posterior wall of the ventricle and thus the left-

most border of the ventricle is thrown to the right of the initial screen mark. A second mark is placed on the screen corresponding to the shadow of the left border of the heart produced by the oblique tangential ray and the distance between these two marks forms the index. Since the left ventricle occupies a position posteriorly in the heart, and since any initial enlargement of the ventricle takes place in this direction without appreciably altering the transverse diameter of the heart, such an estimation as may be afforded by this index should be of value in determining the lesser degrees of enlargement which are not detectable by percussion.



The figures obtained by Morison and White for the normal heart correspond to those obtained by Vaquez and Bordet and show that in the normal subject the index varies between 7 and 14 mm. with an average of 10 mm. at a focal distance of 60 cms.

Morison/

Morison and White further examined a series of cases exhibiting pathological heart conditions. The highest index they record is 42 mm. All of the cases with a high index showed clinical evidence of enlarged hearts, but they further state that in their series "a few cases have been met with where it has been possible to say that hypertrophy exists, but where ordinary screening, percussion and palpation gave no evidence of the same".

Owing to the enlargement generally of the radioscopic shadow at a short focal distance ordinary screen examination does not form a method of precision in estimating the actual size of the object under review.

ORTHODIASCOPY.

Orthodiascopy provides a method of precision even at short focal distance and with it accurate measurements of the heart are obtained. In this method a narrow beam of the rays is used and projected tangentially to the borders of the heart in rotation by shifting the X-ray tube as required. The outline obtained being drawn in by the observer on a cleared film affixed to the fluorescent screen. Since in this way only the normal beam of rays is used which is perpendicular to the screen and tangential to the border of the heart there is no deformation of the orthodiascopic projection, and the orthodiagram obtained furnishes an accurate representation of the heart in respect to/

to its shape and area.

Orthodiagraphy, as the method of obtaining tracings by orthodiascopy is termed, was advocated by Moritz. Since then other workers have devised special apparatus for the perfecting and simplifying of the method notably Groedel and Destot. There can be no question that the method is accurate enough, but it entails considerable experience and dexterity on the part of the radiologist, which consequently introduces a personal factor. The more skilled and resourceful the examiner the more accurate will be the results obtained and vice versa. The co-operation of the patient is also required to obviate alterations of position and abnormal respiratory movements; the method therefore is not generally useful in, for example, the examination of children, nor in unintelligent patients.

Hope Fowler and Ritchie have in this country utilised the semiautomatic orthodiascopic method of Levy-Dorn and Groedel, an excellent account of their observations being recorded with reference to the diagnostic significance of this method in cardiac and aortic disease.

TELERADIOSCOPY.

Teleradioscopy, or screening at a focal distance of at least 2 metres, would be the viewing method of choice, if it were not for the fact that specially powerful apparatus is required, and that a more penetrating beam of rays is necessary, this/

this latter factor causing a more rapid deterioration of the X-ray tube.

A teleradiograph, by which is meant the taking of a radiograph at a distance of at least 2 metres from the focal point, affords the simplest method of reproducing the true outline of the heart. No personal factor is introduced other than the setting of the patient and the centering of the tube. Köhler first introduced this method, which he terms teleröntgenography, and he has used it consistently in his work. Theoretically the further from the focus of the tube the more parallel do the X-rays become, and the less deformed will be the shadow cast by the patient in apposition tothe screen. Various workers have used various focal distances. Vaquez and Laidlaw use 3 metres, Bordet uses 2½ metres, while Köhler uses 2 metres. Even at 2 metres distance the focal aberration is small, amounting to scarcely 5 mm. in enlarged hearts, and 3 mm. in hearts of more normal dimensions. This variation only affects the left side of the heart since that border is further from the mid-sagittal plane of the body than the Right border. Aberration tables are easily obtainable from which corrections may be made if desired for various focal distances, the following table from Köhler shows the aberration of the left contour of the heart in millimeters at a 2 metre focal distance.

Distance of the apex of the heart from the mid-sagittal plane of the body in cms.	Distance of the photographic film from the apex of the heart in cms.				
	4	5	6	7	8
7	1.4	1.7	2.1	2.5	2.9
8	1.6	2.0	2.4	2.9	3.3
9	1.8	2.3	2.7	3.2	3.7
10	2.0	2.5	3.0	3.6	4.1
11	2.2	2.8	3.4	3.9	4.5

Supposing for example a teleradiograph is taken of a patient's heart at 2 metres focal distance and the apex of the heart is estimated to be 9 cms. from the mid-sagittal line and about 6 cms. from the photographic film, then 2.7 mm. must be subtracted from the transverse diameter of the heart in order to obtain a precise determinaion of this diameter.

The technique as adopted and used throughout by the writer consists firstly in examining by radioscopy the thorax and heart of the patient generally both in the antero-posterior and oblique positions any visible abnormalities being duly recorded. The general type of the heart is noted and the aorta is carefully examined as well as the posterior mediastinum. The patient is requested to take deep breaths and the diaphragm movements and movements of the heart with respiration studied.

The Cardioradiographic Index is then taken as accurately as possible, this being found difficult/

difficult to do with young children unless some means of fixation of the patient is adopted.

The tube is then carefully centered over the base of the heart and the patient removed to a distance of 6 feet from the focus of the tube. A teleröntgenogram is then taken at an average exposure of 1¼ seconds. The exposure of anything over one second ensures that the shadow of the heart will show the total outline of systole and diastole of the various chambers, except in a marked case of heart block where special exposures may require to be made.

The question of the phase of respiration at which the exposure should be made has to be considered. Köhler takes his radiographs on a rather full inspiration. It seems that this is not desirable on the grounds that, firstly it cannot be determined whether the patient will take a full inspiration by thoracic breathing or by abdominal breathing and radiographs taken on these two types of respiration will not be comparable, and secondly as it has been shown that the pulsations of the heart are more free on full inspiration the outline of the heart will consequently be more blurred.

The writer has taken all the teleröntgenograms in this series during the expiratory phase of normal quiet respiration.

A tracing is then made of the teleröntgenogram on a superimposed cleared film this having the advantage of leaving the original film undamaged for future reference.

The/

The tracing can generally be made from the superior border of the aortic arch on the left side to the point where the apex of the heart disappears into the left diaphragm shadow, and often beyond this point if the apex shows up through the air cap of the stomach. On the right side part, at least, of the superior vena cava is usually apparent and the right auricle is practically always distinct.

Only occasionally is the right border of the ascending aorta distinctive but a smooth curve can be employed to complete the outer border of the aorta. Similarly the lower border of the heart can be reasonably accurately delimited by a smooth curve. The diaphragms, clavicles and thorax can also be traced in if desired.

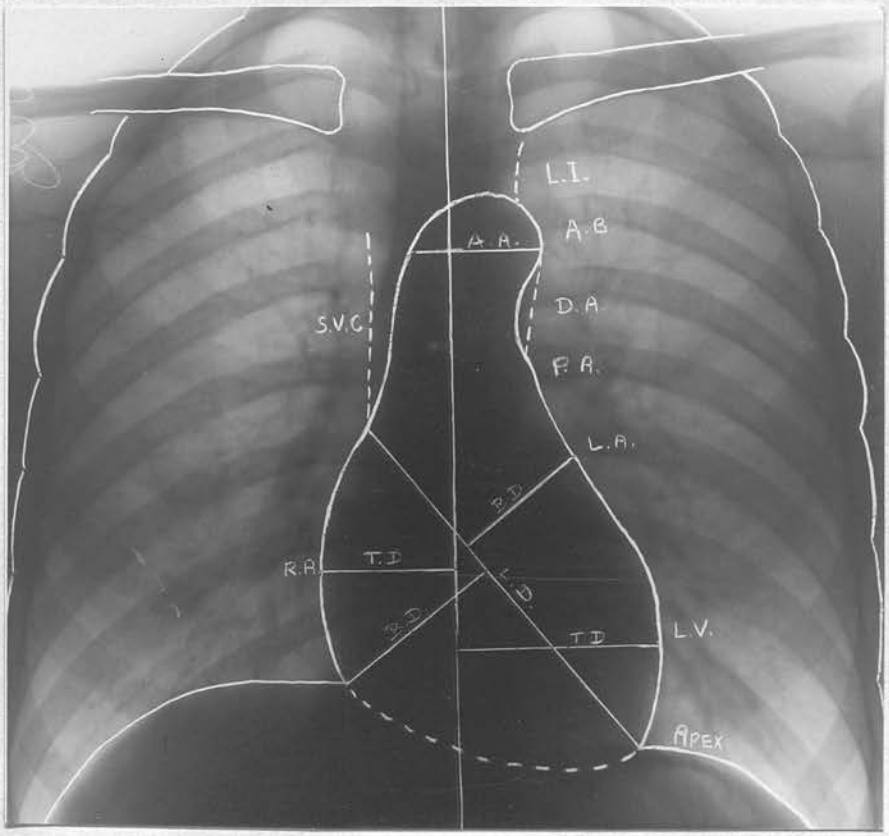
A central line is then drawn as nearly as possible in the mid-sagittal plane of the spine, and from this the diameters are drawn in according to the plan of Groedel.

Perpendiculars from the furthest out points of the right auricle and left ventricle are dropped on the central line and the sum of these two measurements determines the transverse diameter.

A line is then drawn from the apex of the heart to the upper limit of the right auricle this distance determining the longitudinal diameter. From this line perpendiculars are erected firstly to the right auriculo-diaphragmatic junction, and secondly to a point on the left arc of the heart which/

which represents the upper limit of the left ventricle. The summation of these two perpendiculars giving the diameter of the base of the heart. This point presents difficulties in determination. It can in most cases only be localised by orthodiagraphy and its localisation in the longrun is of such doubtful value that most workers now disregard it and measure only the transverse and longitudinal diameters.

Radiograph No.3 shows a tracing of the normal heart shadow as produced by a teleröntgenogram.



A.A. = Aortic Arch
A.B. = Aortic Bulb
L.I. = Left Innominate
D.A. = Descending Aorta
P.A. = Pulmonary Arch
L.A. = Left Auricle
L.V.=Left Ventricle
R.A.=Right Auricle
V.C.=Vena Cava
L.D.=Longitudinal Diameter
T.D.=Transverse Diameter
B.D.=Basal Diameter

The/

The measurement of the transverse and longitudinal diameters usually presents little difficulty. The angle which the longitudinal diameter makes with the central line corresponds to the anatomical axis of the heart which as has been previously stated should be of value in electrocardiography. In hyposthenic individuals or individuals with long narrow chests or who show a physiological type of so called drop heart, (cor pendulum) this angle tends to be more acute, whereas in hypersthenic subjects, short-chested or stout subjects the angle tends to be more obtuse. Moritz, Vaquez, Bordet and Claytor and Merrill have all drawn up tables of these diameters for the normal heart in relation to height or weight of the normal subject for different age periods, and these tabulations have been found to agree tolerably well within the normal limits. In some cases the height, in some the weight and in some the age have been taken as a basis for comparison. Those of Claytor and Merrill in which the weight of the subject determines the grouping are probably the most reliable, and are appended herewith.

CLAYTOR AND MERRILL.

Table 1. Orthodiagrams of Men in Vertical Position

Weight in pounds		Transverse diameter in cm. R.T.D.	L.T.D.	Longitudinal diam. in cm.
109-117	Minimum	10.7		11.8
	Average	10.9		12.6
	Maximum	11.3		13.5
118-126	Minimum	11.0		12.0
	Average	11.8		13.2
	Maximum	12.5		14.0
127-135	Minimum	11.0		12.0
	Average	11.9		13.4
	Maximum	13.1		14.5
136-144	Minimum	11.5		12.5
	Average	12.3		13.5
	Maximum	13.0		15.0
145-162	Minimum	12.0		14.0
	Average	12.4		14.6
	Maximum	13.8		15.3
163-181	Minimum	11.0		14.0
	Average	12.9		14.7
	Maximum	13.4		15.8

CLAYTOR AND MERRILL.

Table 11. Orthodiagrams of Women in Vertical Position

Weight in pounds		Transverse diameter in cm.	Longitudinal diam. in cm.
91-99	Minimum	9.9	12.0
	Average	10.2	12.1
	Maximum	10.5	12.3
100-108	Minimum	10.0	11.5
	Average	10.7	11.9
	Maximum	11.1	12.4
109-117	Minimim	10.2	10.5
	Average	11.0	12.2
	Maximum	12.2	13.8
118-126	Minimum	9.6	11.2
	Average	11.2	12.4
	Maximum	12.6	13.3
127-135	Minimum	10.0	12.2
	Average	11.1	12.7
	Maximum	11.8	13.2
136-144	Minimum	10.9	12.3
	Average	11.6	12.9
	Maximum	12.8	14.2
145-159	Minimum	10.6	11.8
	Average	11.7	12.6
	Maximum	12.6	13.2

The next determination is that of the surface area of the heart.

Most of the writers on this measurement adopt the plan of Groedel which is to join by a smooth curve the predetermined point on the left side representing the upper limit of the left ventricle, to the point on the Right side which indicates the upper border of the right auricle. The points of intersection of the heart shadow with the diaphragms on either side are also joined by a smooth curve and the ovoid enclosed by these lines is measured with an Amsler planimeter.

Moritz set up standards of normal cardiac area in relation to the height of the subject and his results may be tabulated as follows:-

Height.	Variation of Area	Average Area
153-157 cm.	80 to 100 sq.cm.	98 sq.cm.
161-169 cm.	87 to 108 sq.cm.	102 sq.cm.
171-178 cm.	92 to 120 sq.cm.	109 sq.cm.

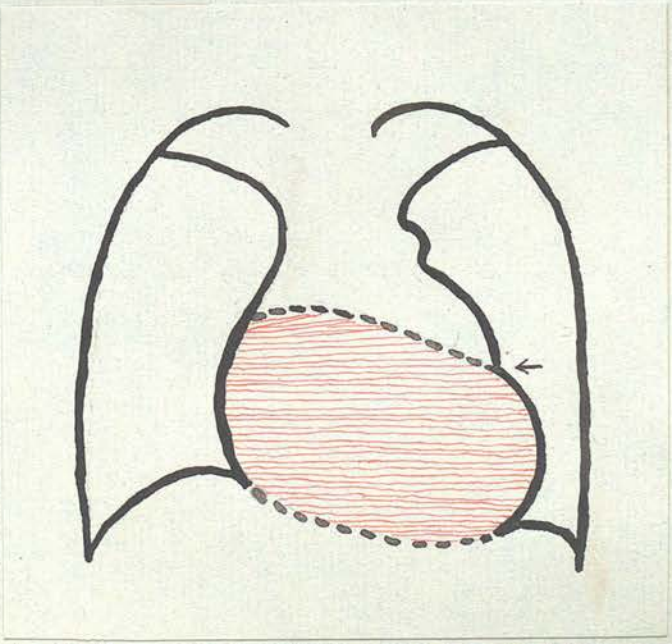
Claytor and Merrill in their estimations compared the cardiac area with the height and weight of the individual and found that while there was no definite relationship between cardiac area and height, a more or less definite relationship appeared to exist between cardiac area and weight.

The cardiac area is generally quite easily measured by the method of Groedel in hearts of more or less normal appearances, but in pathological hearts/

hearts owing to the alteration of the position of the before mentioned points measurement of the surface area frequently presents great difficulty.

On anatomical grounds the writer is of opinion that the measurement by Groedel does not represent a fair estimate of the total cardiac area in enlarged states, since in the method already described a considerable portion of the left auricle at least is left out of account, and also the base of the heart which usually takes part in any generalised cardiac enlargement. Moreover it is observed that in many cases the pulmonary arch and the aorta share in the cardiac enlargement to a greater or lesser extent.

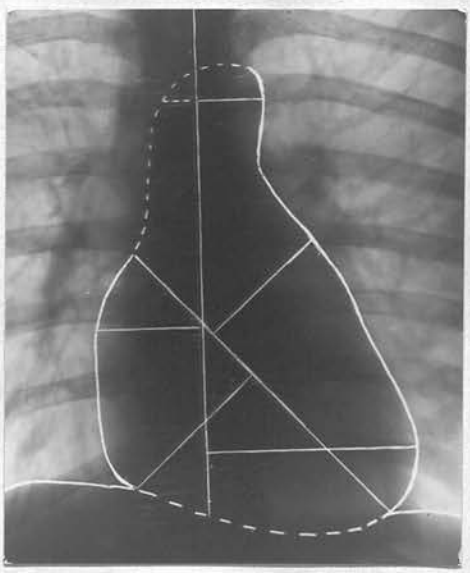
If for example we take the tracing of a case by Vaquez as shown in black lines in the diagram below and fill in by curves the upper and lower limits we observe that we have left out of consideration in our measurement of the cardiac area (shaded in red) a greatly distended auricle and widened heart base.

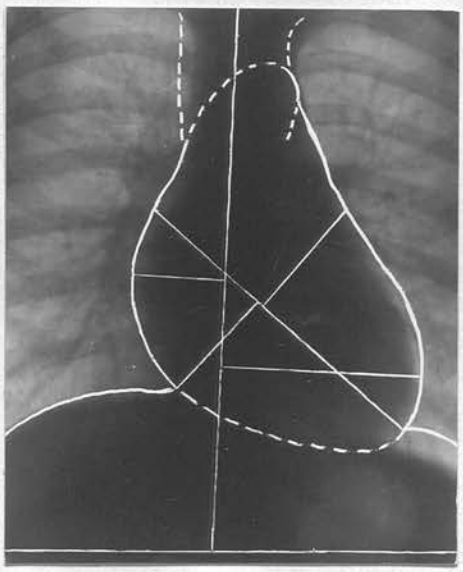


It occurred to the writer that the simplest method of determining the area of any heart would be to measure the total cardiac area, including the aortic shadow, this measurement providing a fairer estimate in all pathological states of the greater or lesser degrees of cardiac enlargement.

Occasionally the complete aortic shadow can be definitely outlined, and in those cases in which it cannot be precisely determined it can be presumed within reasonably narrow limits.

In the two heart tracings shown below, the continuous white lines are easily obtainable from the cardiac shadow, and it appears quite rational to complete the outline of the aorta as shown by the dotted lines. The lower border of the heart is delimited after the manner of Groedel.





Taking the area, as obtained by the method of Groedel, for the surface projection of the heart of a normal healthy adult male we find that it is approximately 90 sq.cm. By the method used herein the/

the total cardiac area for the normal healthy adult male is approximately 130 sq.cm. an increase of 44.4 per cent.

This method of estimating the area of the total cardiac shadow has been adopted throughout this investigation.

If the heart is considered purely from a physical standpoint, we should expect to find in two similar individuals of the same physical activity an accurate correlation between their cardiac dimensions, but as no two individuals are absolutely alike, so no two hearts are identical in every respect, and we can only arrive at an estimate of what the cardiac dimensions ought to be in relation to the individual. In order to relate the heart to an individual we must adopt some method of measuring the individual. Many and various methods have been so tried; the Cardio-thoracic Ratio of Danzer; the method of Van Zwaluwenburg of expressing the product of the cardiac diameters as a function of the weight of the subject; the Index-method of Lauri Taipale which takes the width of the shoulders into account; and finally the measurement of the wrist as an index of the size of the heart.

Physical laws would suggest that a closer relationship may be found to exist between the size of the heart and the mass of the body tissue which the heart has to supply with blood. The surface area of the body, which is a factor of the height and weight of the individual, can be/

be accurately determined and is an expression of the mass of the body tissue. The surface area of the heart is a factor of the size of the heart. It follows, therefore, that if we relate the surface area of the heart with the surface area of the body we should obtain an index which will hold good for different individuals under similar circumstances.

This relationship should remain constant in an adult with only small variations due to fluctuations in body weight, since the height of an adult and the size of the heart virtually remain constant from year to year.

In children on the other hand the heart is relatively larger in proportion to the body than in the adult, tending about the age of puberty to assume the adult proportion.

It is understood that clinically perhaps the most important physical observation to be made in the detection of heart disease lies in the estimation of the size of the heart, since in the great majority of pathological hearts enlargement of the organ in one or other direction is a constant finding.

Percussion alone is not an accurate enough guide to minor degrees of enlargement, the measurement of the transverse diameter of the heart by radiological methods can only indicate enlargement in breadth whereas the measurement of the total cardiac area is considered/

considered to give a more accurate estimate of even the lesser degrees of enlargement in the majority of cases.

There must always remain however the difficulty of assessing the variations in size of the heart within the normal limits, and many factors must of necessity be taken into consideration for each individual before any critical estimate of enlargement can be made.

Wilson and Merrill go so far as to state that "not only height and weight, but the body surface, the sitting height, the heart rate, the age, the diameters of the chest, the angle of inclination of the long axis of the heart and the amount of physical exertion to which the subject is accustomed should be recorded, so that the influence of each may be determined."

This is undoubtedly the case before the limits within the normal range can be reduced to a minimum, but the calculations necessary when taking all these factors into consideration would appear to become somewhat involved.

For the present in this series of cases the percentage area of the heart to body surface is expressed, and the cases are grouped according to their ages and to the severity of the cardiac embarrassment. The consideration of the age in children is important as previously mentioned, since the heart of the child is larger, relative to the body, than that of the adult.

It is regretted that sufficient normal subjects were not available in different age groups for comparison, but twenty-three healthy medical students were examined and those of close standards were measured, the following data being obtained:-

Average age	= 23 years.
Average weight	= 151 pounds.
Average height	= 69½ inches.
Average body surface area	= 1.81 square meters.
Average cardiac area	= 130 square centimeters.
Percentage of cardiac area to body surface area	= .718 per cent.

We may thus state that in the average young adult male the surface area of the heart, as measured by the method already described, should approximate to .7 per cent of the body surface area of the individual.

It is hoped to be shown by reference to those cases which have been examined on more than one occasion, that apparently the surface area of the heart can be measured within reasonably narrow limits as demonstrated by the increase in surface area with growth in children.

There was no intention in this investigation to attach any diagnostic significance to the cases under review, but rather to determine whether or not there was any distinctive variation in the ratio between heart size and body size when the cases were grouped according to the severity of the cardiac lesion.

The cases which were sent for radiological examination had received careful clinical examination and were grouped into classes by the clinician in accordance with the following system:-

CLASS D. No evidence of heart disease.

CLASS C. Potential heart disease. Exposure to recent infection, but no definite signs present of heart involvement.

CLASS B. Doubtful heart disease. Abnormal signs present but not believed to be due to organic disease.

CLASS A. 1. Organic disease present.
2. Advanced organic disease. Ability for physical effort diminished.
3. Advanced organic disease with signs of heart failure at rest.

The cases examined will now be considered On referring to the first case shown (NO.110) the general scheme of description of the cases is given in more detail,there being represented for each case ,the case number,the sex and the age at first examination. The clinical aspect of the case follows in an abbreviated form with the position of the apex,or left border of the heart,in relation to the mid-clavicular line. Then follows the classification of the case according to the system of the grouping as adopted by the clinician. The radiographic measurements of the longitudinal

and transverse diameters of the heart,and the surface area of the heart are recorded. The other measurements being left out of account in this investigation. The surface area of the body and the ratio of the surface area of the heart to the surface area of the body (expressed as a percentage) is then given and a short summary correlating the radiographic appearances with the clinical findings.

At the beginning of each class there is a tabulated record of all the cases in that class showing the maximum,minimum and average percentages obtained.

SUPPLEMENT OF CASES

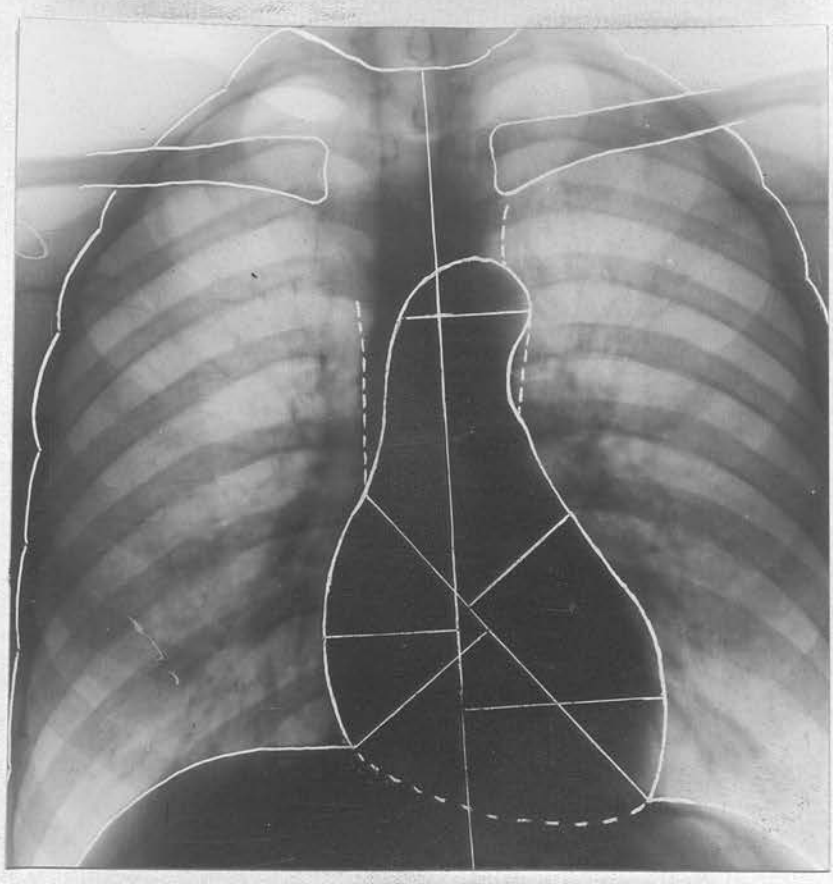
CLASS D.

This group includes four cases of normal hearts, the first one shown being that of one of the twenty-four students whose heart most closely approximated to the average.

Case No.	Sex.	Age.	Ratio.
110	M.	23 yrs.	.718%
46	F.	15 "	.712% (Dec.27)
			.628% (Dec.28)
23	F.	11 "	.788% (Feb.28)
			.860% (Mar.28)
			.672% (Oct.28)
38	F.	8½ "	.637%

The lowest percentage in this group is .628% in a girl of 15 years, the highest reading being .860% in a girl of 11 years whose apex at that time was ½ cm. outside the mid-clavicular line. As her heart was apparently enlarged at that time we should take her lowest reading for her normal.

The average reading for CLASS D is thus calculated to be .673%.



Case No. 110. Male. 23 yrs.

No evidence of any heart disease, nor any antecedent history likely to affect the heart.

Normal heart.

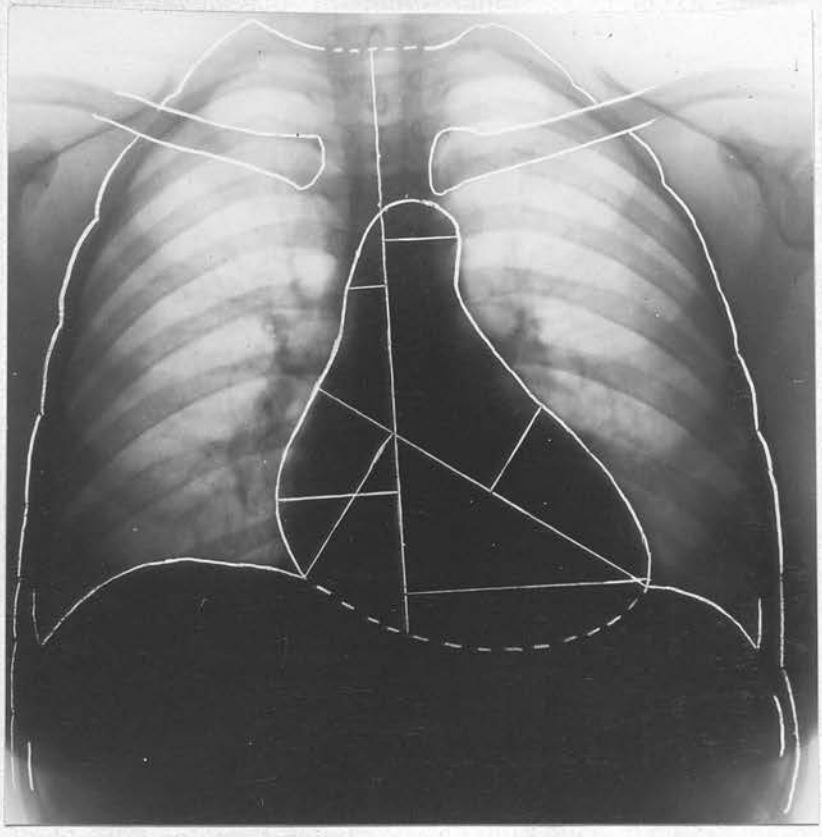
CLASS D.

Radiographic Measurements.

Long. Diam.	Trans. Diam.	Heart Area.	Surface Area of body	Percentage of Heart Area to Surface Area.
13.2 cm.	11.0 cm.	130.0 sq. cm.	1.81 sq. m.	.718%

The above tracing shows an apparently normal cardiac outline as seen in a healthy young adult male.

Note the percentage area of .718%



Case No.46. Female. 15 yrs.

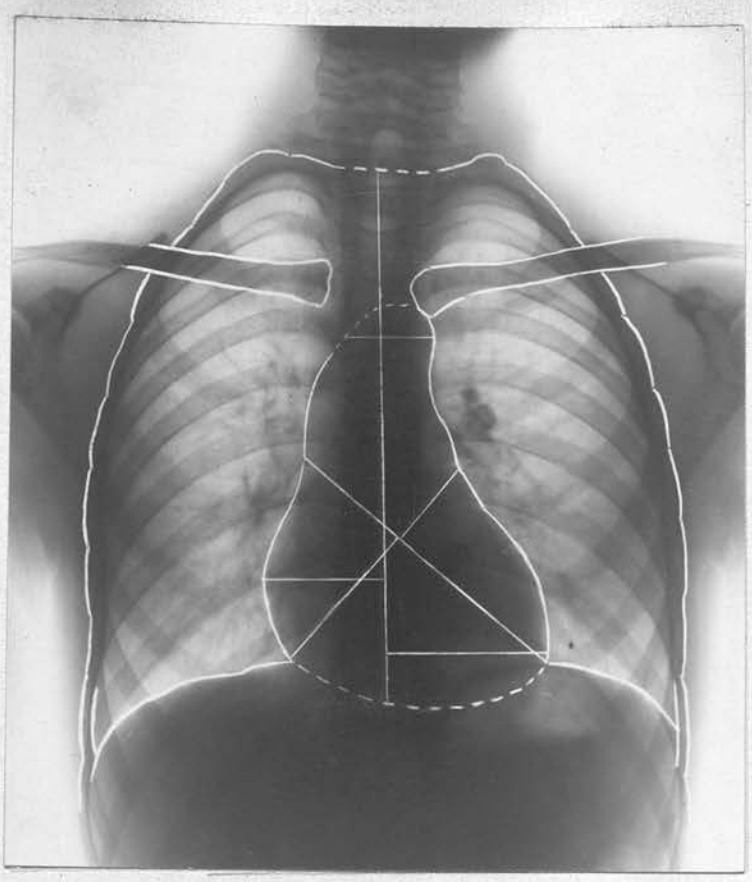
Dec. 27. Old chorea. No clinical evidence of heart disease now. Heart not enlarged. No murmur
Dec. 28. Normal heart after chorea.

CLASS D.

Radiograph Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	12.7	11.8	109	1.53 = .712%
Dec. 28.	12.4	11.8	108	1.72 = .628%

No abnormality apparent in radiogram.
The heart area has remained approximately the same and the average percentage area is low.



Case No. 23. Female. 11 yrs.

Feb. 28. Rheumatic history. Doubtful Ventricular enlargement. No valve lesion detected.
M.C.L. 6½, Apex 6½.
Mar. 28. M.C.L. 6½, Apex 7.
Oct. 28. M.C.L. 7, Left border 6½ in 5th. space.

At first examination a case of potential heart disease and placed in class C. Later placed in class D since no evidence of heart disease.

CLASS D.

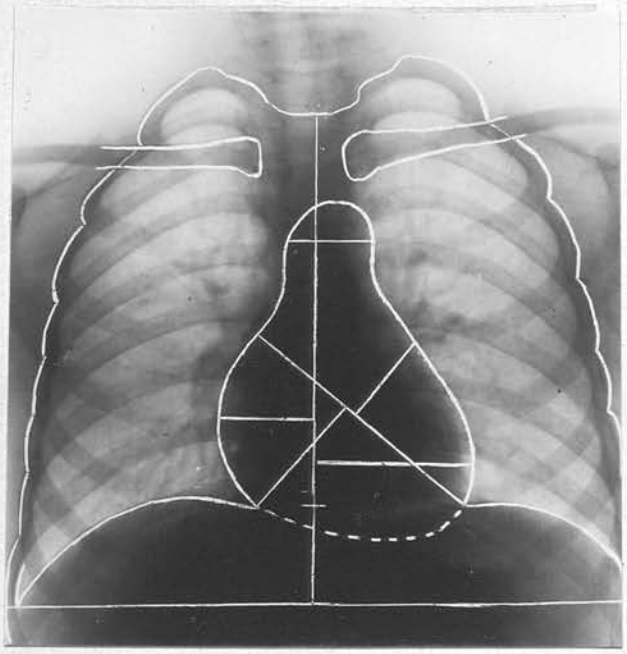
Radiographic Measurements---

	L.D.	T.D.	H.A.	S.A.	
Feb. 28.	9.7	9.1	78	.99	= .788%
Mar. 28.	10.4	9.6	86	1.00	= .86 %
Oct. 28.	9.2	8.8	75	1.12	= .672%

The only abnormality seen in this case is a temporary enlargement of the heart. There is no undue prominence of the left auricle. The X-ray examination substantiates the clinical findings, and the percentage area is low, in the last measurement. The radiograph shown above is that taken in February 1928.

Note how the percentage area follows the clinical findings.

1. Apex at M.C.L. percentage area .788%
2. Apex beyond M.C.L. " " .860%
3. Apex within M.C.L. " " .672%



Case No.38. Female. 8½ yrs.

Dec. 28. Normal child. Normal heart.
M.C.L.6¼ Apex 5¼

CLASS D.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 28.	8.6	8.1	58	.91 = .637%

Radiograph shows normal appearance of heart. Note low percentage area of .637

CLASS C.

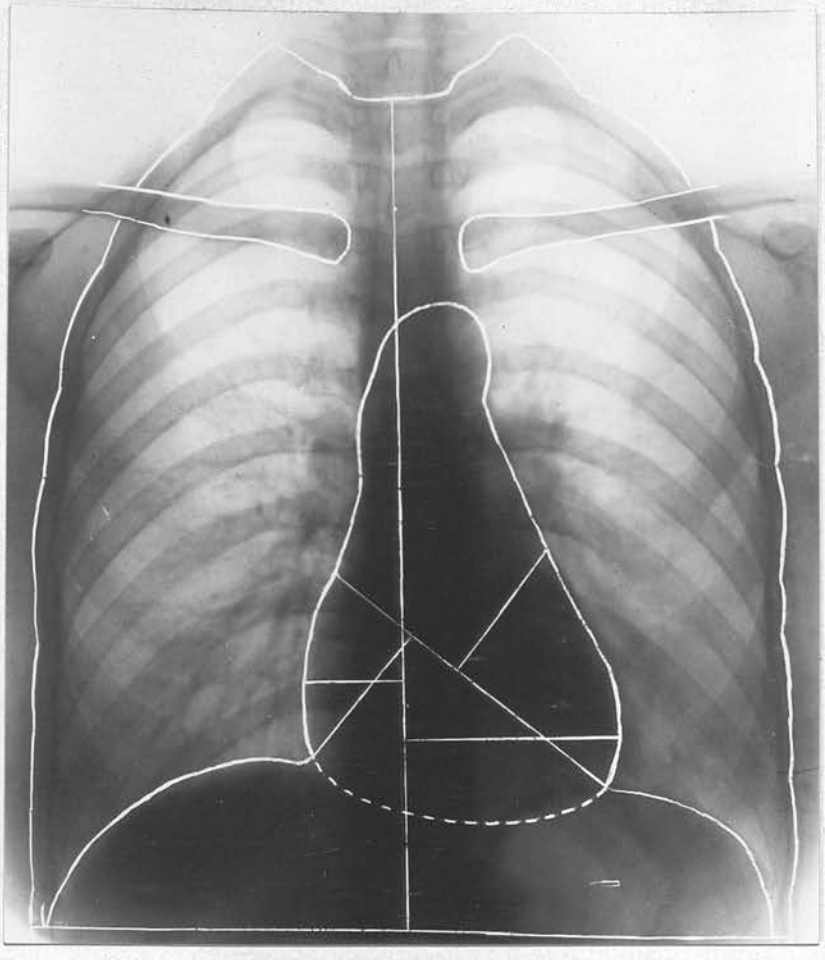
This group comprises ten cases of potential heart disease.

Case No.	Sex.	Age.	Ratio.	
13	F.	20 yrs.	.720%	
74	M.	15 "	.693%	
99	M.	13 "	.711%	
96	M.	13 "	.730%	(Dec.27)
			.711%	(Mar.28)
93	F.	9½ "	.802%	
82	F.	9 "	.793%	
83	F.	8 "	.818%	
72	F.	7 "	.785%	(Feb.28)
			.858%	(Nov.28)
26	F.	6½ "	.845%	(Dec.27)
			.896%	(May 28)
80	M.	5 "	.865%	

The lowest percentage in this class is .693% in a girl of 15 years, the highest being .896% in a girl of about 7 years of age.

The average percentage area for this class is .787%

The above figures show in a general way that the younger the subject the higher the ratio. With however more cases at each age group, separated according to the sex, a more definite gradation in the ratios would probably be presented.



Case No.13. Female. 20 yrs.

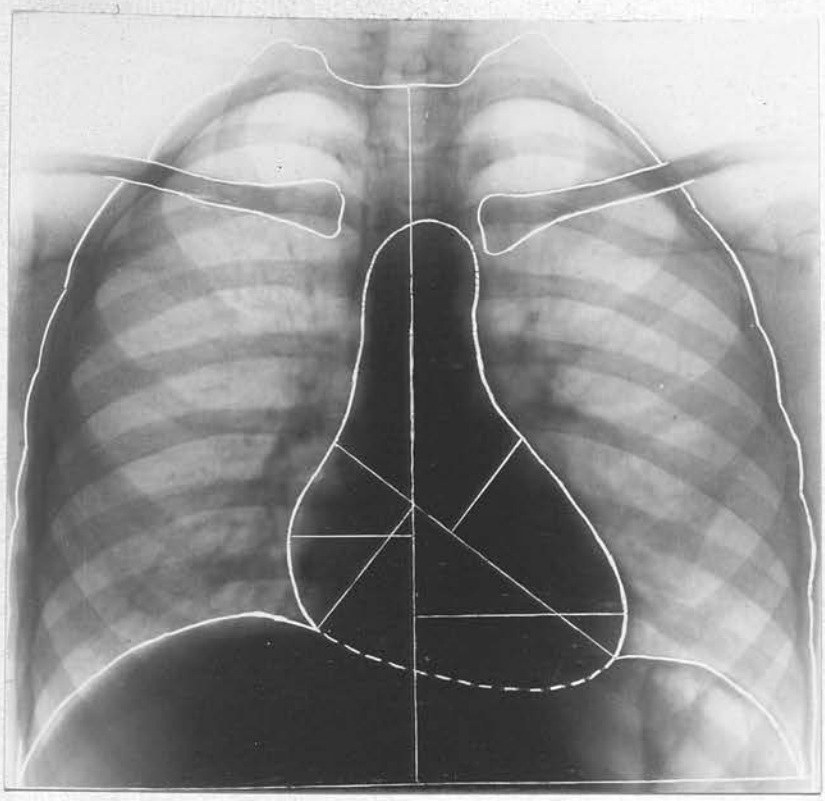
Jan. 29. Sub-acute rheumatism. No evidence of cardiac damage at present. Heart not enlarged. No murmur.
Potential heart disease.
M.C.L. 8 Apex 7½

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Jan. 29.	10. 9	10.0	107	1.475 = .72%

Radiograph presents no abnormality of contour. Diameters and area of normal measurements



Case No. 74. Male. 15 yrs.

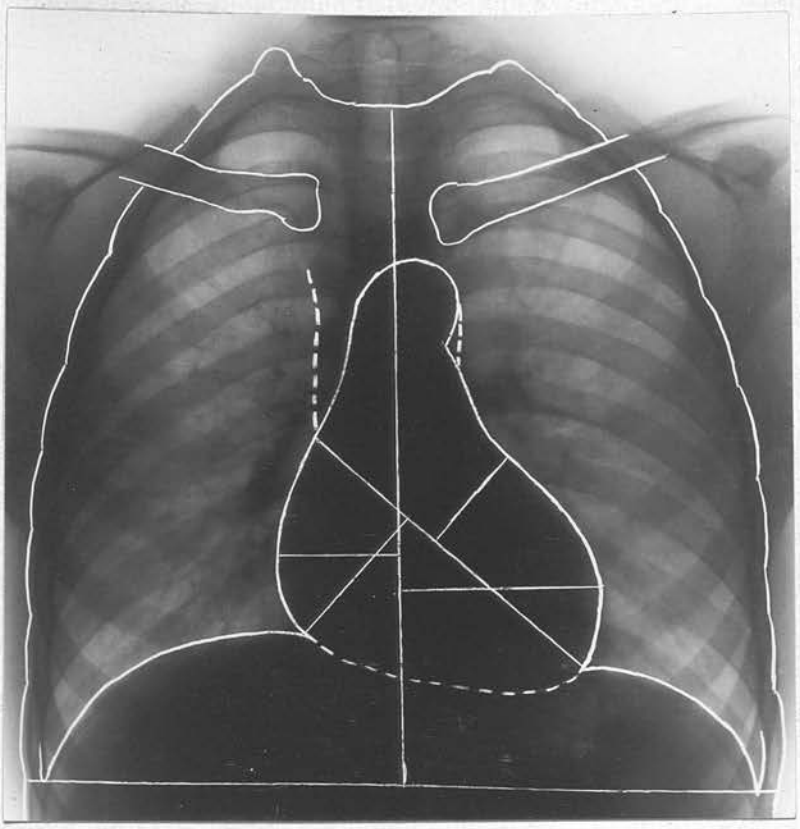
Feb. 29. Rheumatic child. Normal heart.
M.C.L.8 Apex 7

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 29.	11.3	10.8	97	1.40 = .693%

Radiograph does not show any marked abnormality.
Percentage area low.



Case No. 99. Male. 13 yrs.

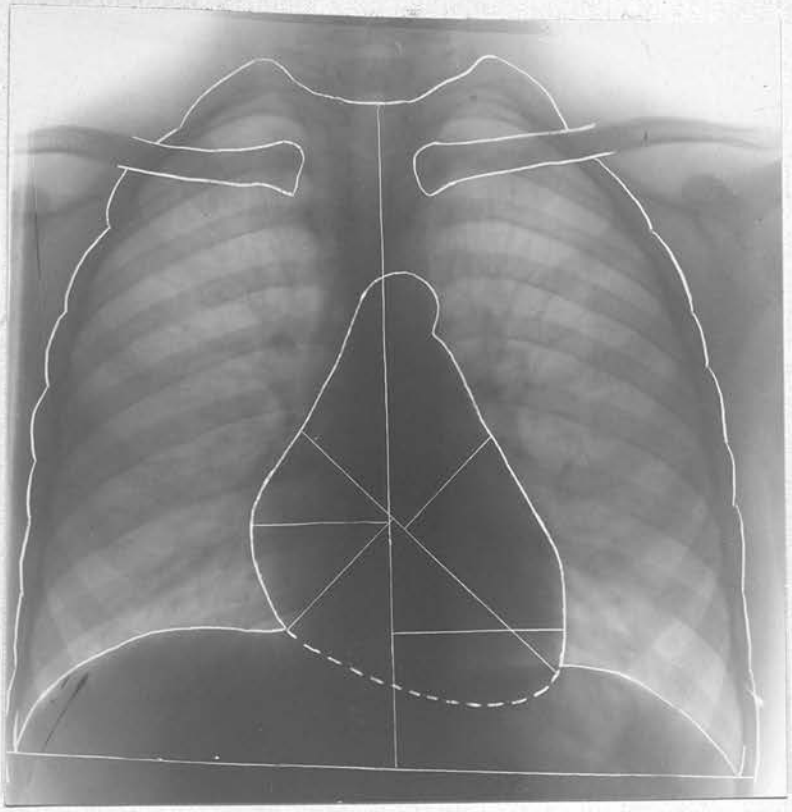
Feb. 29. Rheumatic child. Normal heart. No murmurs.
M.C.L.$7\frac{1}{4}$ Apex $6\frac{3}{4}$ in 5th space.

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 29.	11.4	10.3	91	1.265 = .7114%

Radiograph shows no abnormality. Percentage area low.



Case No.96. Male. 13 yrs.

Dec. 27. Sub-acute rheumatism. Slight ventricular dilatation with a soft blowing systolic murmur localised to apex.

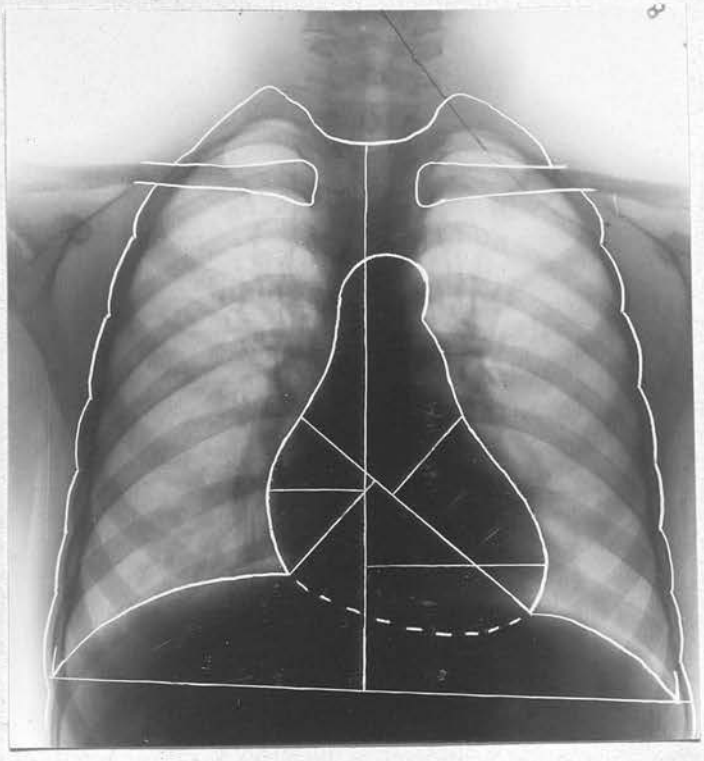
Mar. 28. No murmur now;heart possibly a little smaller.
M.C.L.8 Apex 8¼ in 5th space.

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	12.0	10.5	92	1.26 = .730%
Mar. 28.	11.4	10.0	90	1.25 = .711%

Radiograph does not show any pronounced abnormality, apart from some general enlargement.
Percentage area within normal limits.



Case No.93. Female. 9½ yrs.

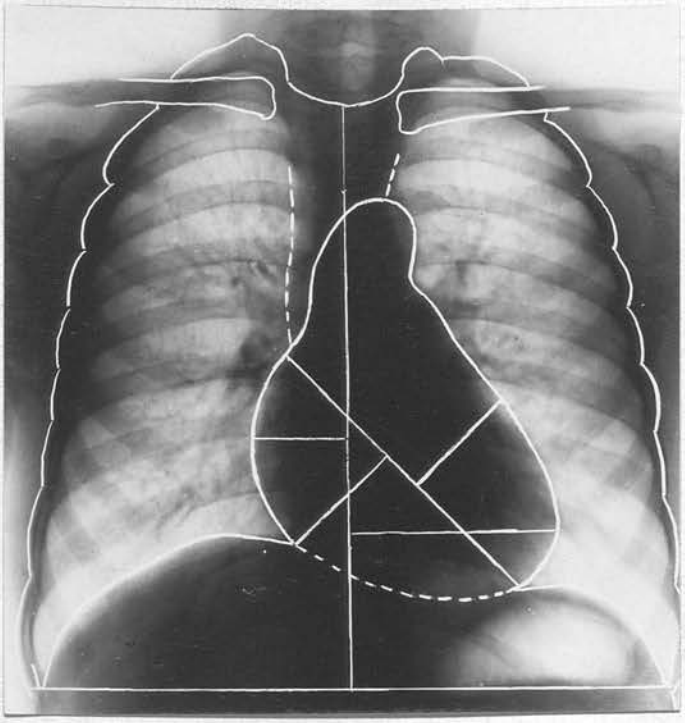
Dec. 28. Rheumatic child. Normal heart.
M.C.L.6¾ Apex 5¾

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 28.	9.7	8.9	67	.835 = .802%

Radiograph shows no definite abnormality.



Case No.82. Female. 9 yrs.

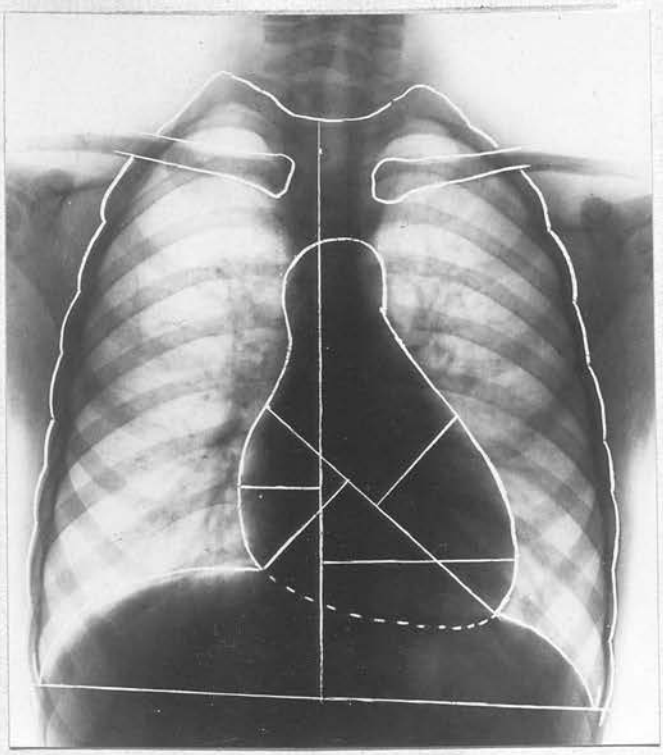
Oct. 28. Rheumatic history. Dilated heart. No murmur.
M.C.L.7 Left border 7¼
Potential heart disease.

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Oct. 28.	10.5	9.7	77	.97 = .793%

Radiograph shows no definite abnormality other than the appearance of some left ventricular hypertrophy.



Case No.83. Female. 8 yrs.

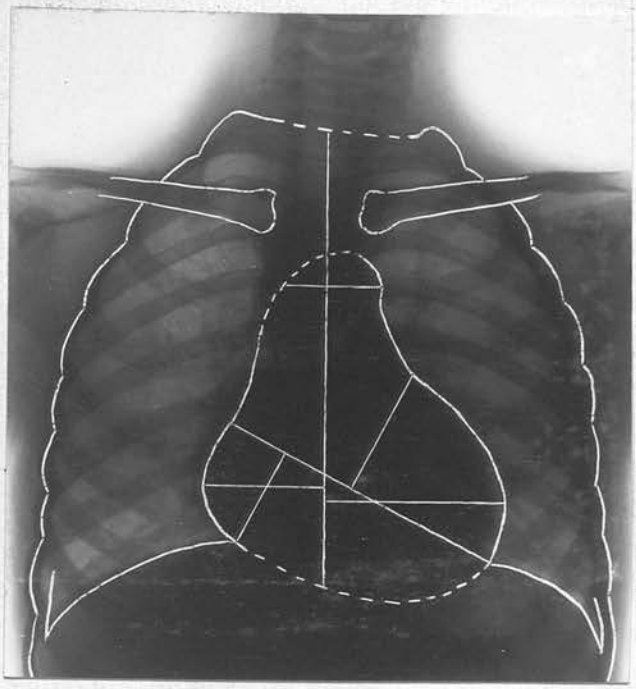
June 28. Rheumatic child. Normal heart.

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
June 28.	10.0	8.9	72	.88 = .818%

Radiograph shows no definite abnormality other than slight increase in size of left heart.
Percentage area above average - potential heart disease.



Case No. 72. Female. 7 yrs.

Feb. 28. Rheumatic child. No evidence of cardiac involvement at present.
M.C.L.6¼ Left border 6

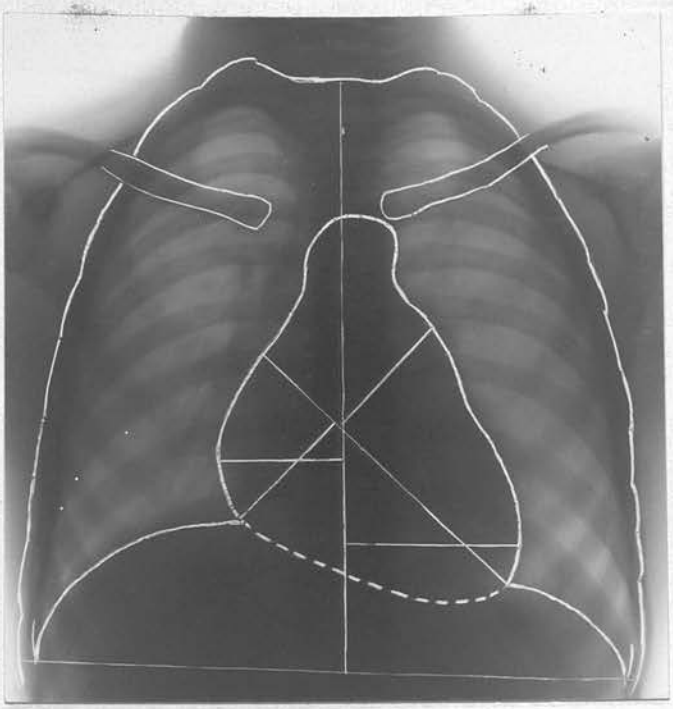
Nov. 28. No murmur present. 1st sound a little rough.
M.C.L.6½ Left border 6

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	9.6	9.7	70	.80 = .785%
Nov. 28.	10.2	9.2	73	.85 = .858%

Radiograph shows no definite abnormality Percentage area has risen. this may indicate potential heart disease.



Case No. 26. Female $6\frac{1}{2}$ yrs.

Dec. 27. Rheumatic history. Chorea. Heart not enlarged but Mitral sistolic murmur present.
Mar. 28. M.C.L. 7, Left border 6.5
May. 28. M.C.L. 7, Left border 6.5

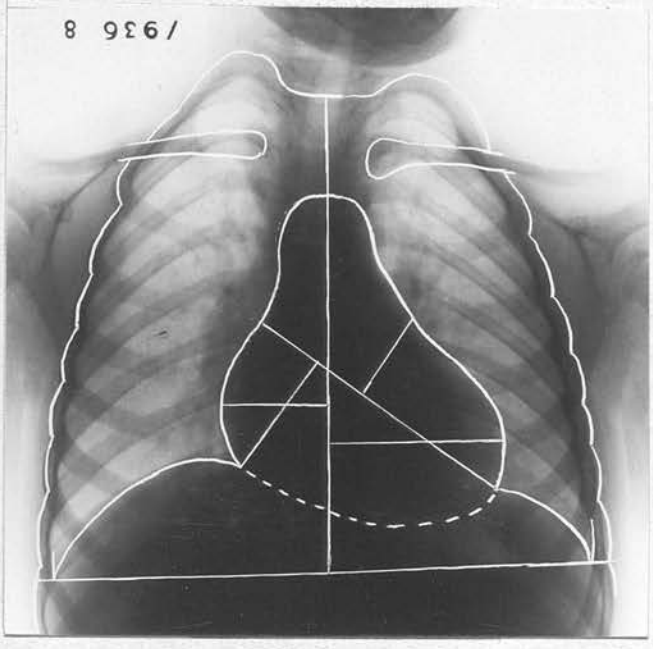
Potential heart disease.

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	10.3	9.4	71	0.84= .845%
Mar. 28.	10.8	9.6	77	
May. 28.	10.6	9.8	78	0.87= .896%

Radiograph shows undue prominence of left Auricle very suggestive of mitral stenosis. The percentage area has increased and Class B is suggested rather than Class C.



Case No.80. Male. 5 yrs.

Feb. 28. Rheumatic history. Functional systolic murmur. No heart disease at present.
M.C.L.$5\frac{3}{4}$ Apex $5\frac{3}{4}$

CLASS C.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	9.2	9.1	61	.705 = .865%

Radiograph does not present any visible abnormality.

CLASS B.

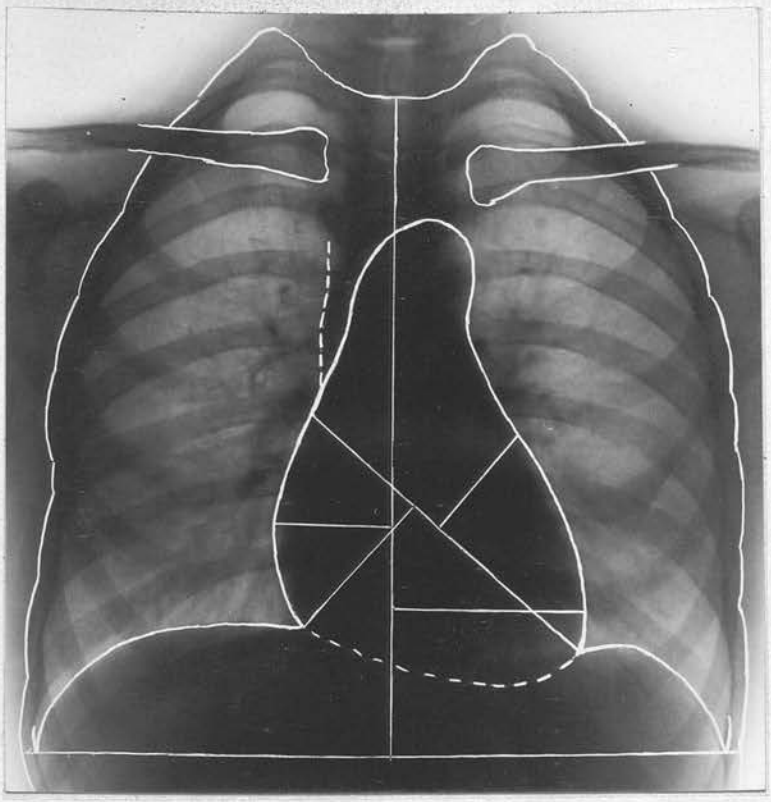
This group comprises twelve cases of probable heart disease, the last one being a borderline case classified at the second examination as having organic disease present.

Case No.	Sex.	Age.	Ratio.
54	F.	12 yrs.	.691% (May 28)
			.690% (Sep.28)
			.753% (Feb.29)
43	F.	10 "	.790% (Feb.28)
			.812% (Sep.28)
44	M.	10 "	.728% (May 28)
			.780% (Nov.28)
10	F.	7½ "	.974%
30	F.	7 "	.885%
42	F.	7 "	.765% (Mar.28)
			.820% (May 28)
			.857% (Oct.28)
39	M.	7 "	.936%
32	M.	6 "	.768% (Feb.28)
			.877% (Sep.28)
57	F.	5½ "	.770%
56	F.	5½ "	.876% (Dec.27)
			.868% (May 28)
4	M.	8 "	.796% (Feb28)
			.891% (Jan29)
11	M.	7 "	1.030% (Mar28)
			1.010% (Oct28)

The two last cases, Nos. 4 and 11 were on further examination found to have organic disease present and were transferred to Class A 1.

The lowest percentage in this group is .690% in a girl of 12 years, the highest percentage (not including the last two cases) is .974%.

The average reading for Class B is found to be .813%.



Case No.54. Female. 12 yrs.

May. 28. Rheumatic. Slight mitral leak.
M.C.L.7½ Left border 9

Sept.28. Mitral disease. Heart now smaller, murmur less distinct and child appears stronger. Faint systolic at apex.
M.C.L.7½ Apex7½

Feb. 29. Mitral leak. Heart now appears larger.
M.C.L.7½ Apex8

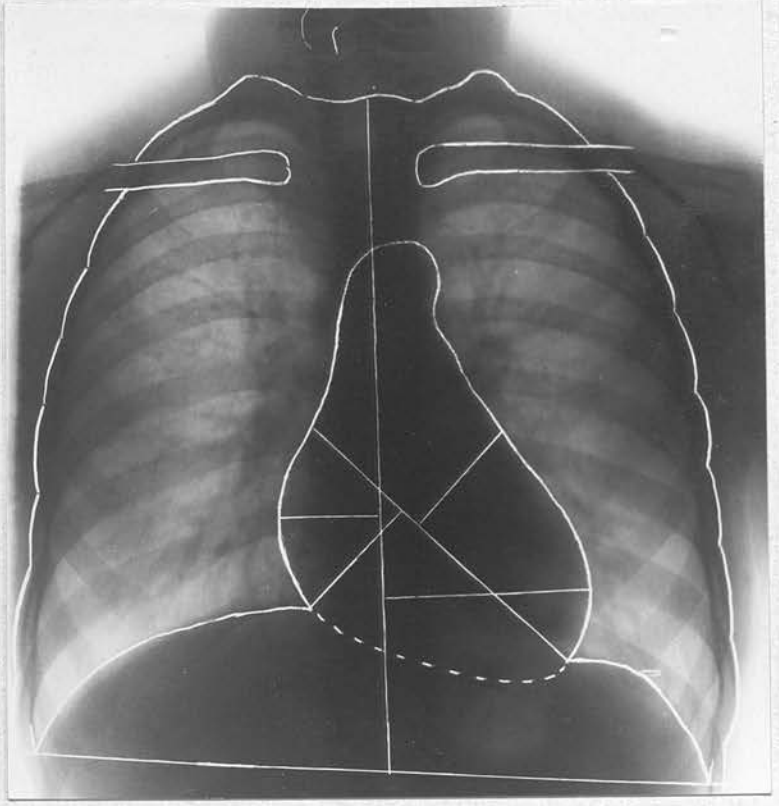
CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.	
May. 28.	10.8	9.5	83	1.20	= .691%
Sept.28.	11.0	10.0	87	1.26	= .690%
Feb. 29.	11.6	10.0	98	1.30	= .753%

Radiograph shows slight diffuse prominence of left auricular area suggestive of incompetence.

Note how the percentage area follows the clinical findings, the final rise to .753% suggesting possible heart disease.



Case No.43. Female. 10 yrs.

Feb. 28. Rheumatic history. Chorea. Probable early mitral stenosis. No presystolic but thudding 2nd sound.
Potential heart disease, but probably not organic.
M.C.L.$7\frac{1}{2}$ Left border $7\frac{1}{2}$ in 5th space.
Sept. 28. M.C.L.$7\frac{3}{4}$ Left border $7\frac{1}{2}$

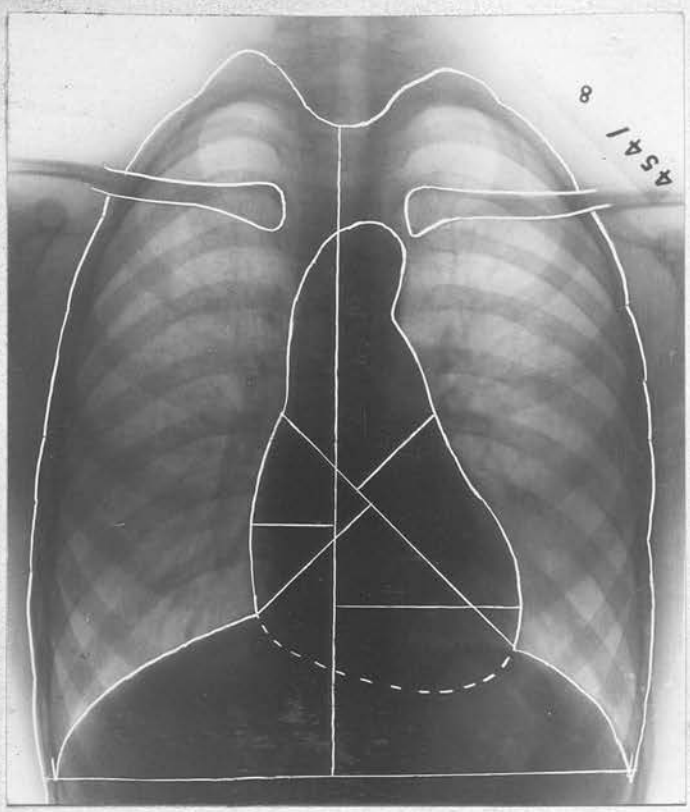
CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	11.1	9.9	84	1.06 = .790%
Sept. 28.	11.6	11.0	91	1.12 = .812%

Radiograph shows slight prominence of left auricular and pulmonary areas.

Percentage area has only increased by .02 in seven months, but indicates potential heart disease.



Case No.44. Male. 10 yrs.

May. 28. Not rheumatic. Possible mitral regurgitation. Possible functional. Systolic murmur.
M.C.L.$7\frac{1}{4}$ Apex $7\frac{1}{2}$

Nov. 28. Still systolic murmur, more marked on inspiration.

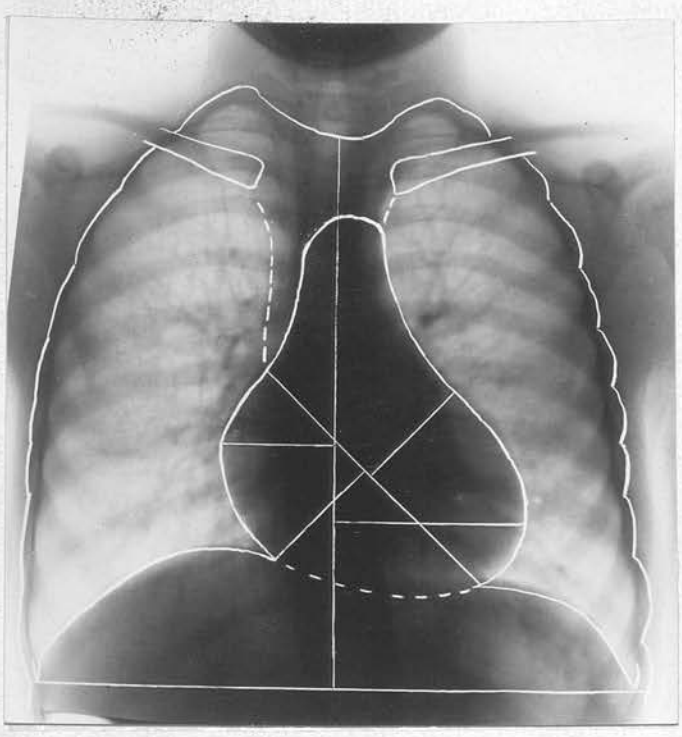
CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	10.1	8.6	79	1.085 = .728%
Nov. 28.	10.6	8.7	85	1.09 = .780%

Radiograph does not show any undue prominence of left auricle. Murmur probably functional.

Percentage area low.



Case No.10. Female. 7½ yrs.

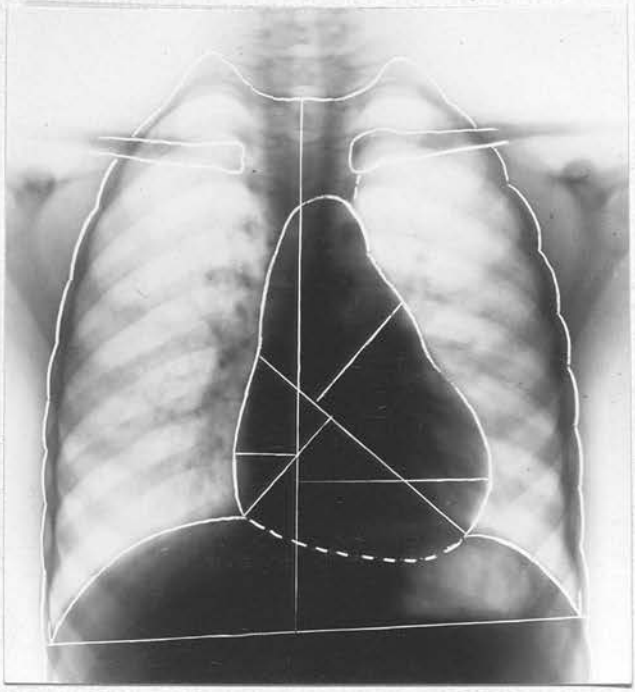
Feb. 28. Rheumatic history. Chorea. Mitral systolic murmur . Dilated heart.
Potential heart disease.
M.C.L.6¼ Left border 6½

CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	9.7	9.8	75	.77 = .974%

Radiograph shows general enlargement with some hypertrophy of left ventricle.
Percentage area rather high for age.



Case No.30. Female. 7 yrs.

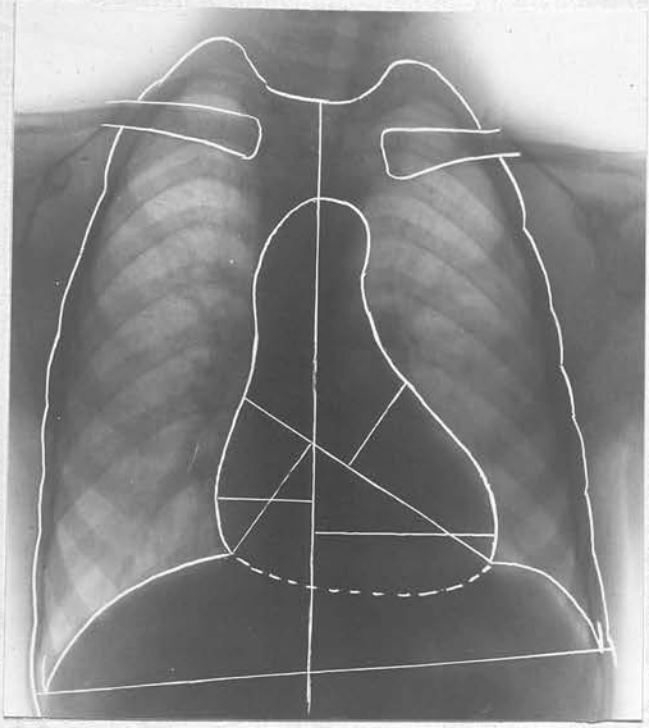
Mar. 28. Rheumatic history. Mitral regurgitation.
M.C.L.6¾ Left border 6¾ in 5th space.
Possible heart disease.

CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	8.9	6.2	66	0.745 = .885%

Radiograph shows undue prominence of left auricle, possibly only myocardial in the absence of organic disease.
The percentage area is not high.



Case No.42. Female. 7 yrs.

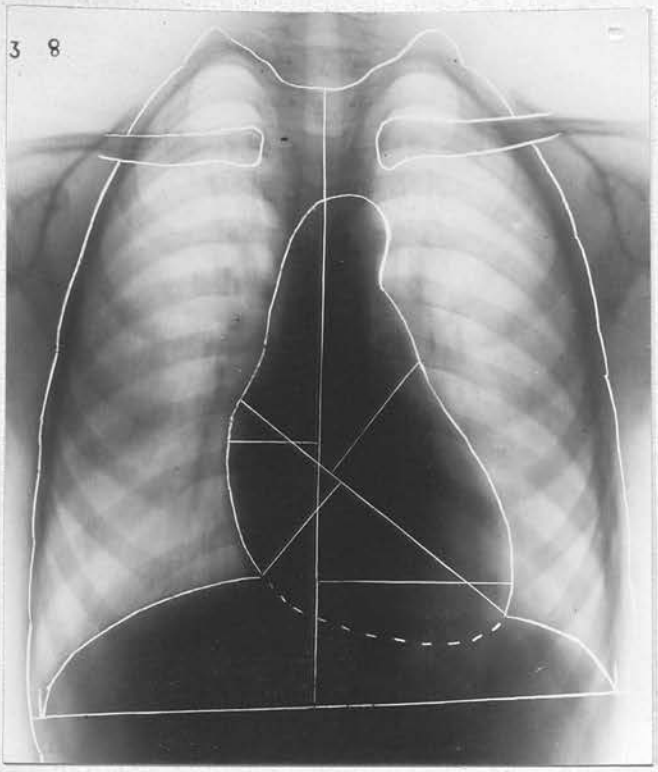
Mar. 28. Rheumatic history. Doubtful heart. No evidence--definite--of endocarditis.
M.C.L.6 Left border 6¼
May, 28. Faint mitral murmur.
M.C.L.6 Left border 6¼
July.28. Suggestion of slight cardiac hypertrophy Left border just outside M.C.L. No murmur.
M.C.L.6 Left border 6¼
Oct. 28. Heart appears slightly enlarged. Normal heart.
M.C.L.6¼ Left border 6¼

CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	9.5	9.1	62	.819 = .765%
May. 28.	9.1	9.0	67	.815 = .820%
Oct. 28.	9.5	8.9	72	.840 = .857%

Radiograph presents no definite abnormality other than confirming a somewhat enlarged heart. The rather high average percentage area of .81 confirming possible heart disease--class B.



Case No.39. Male. 7 yrs.

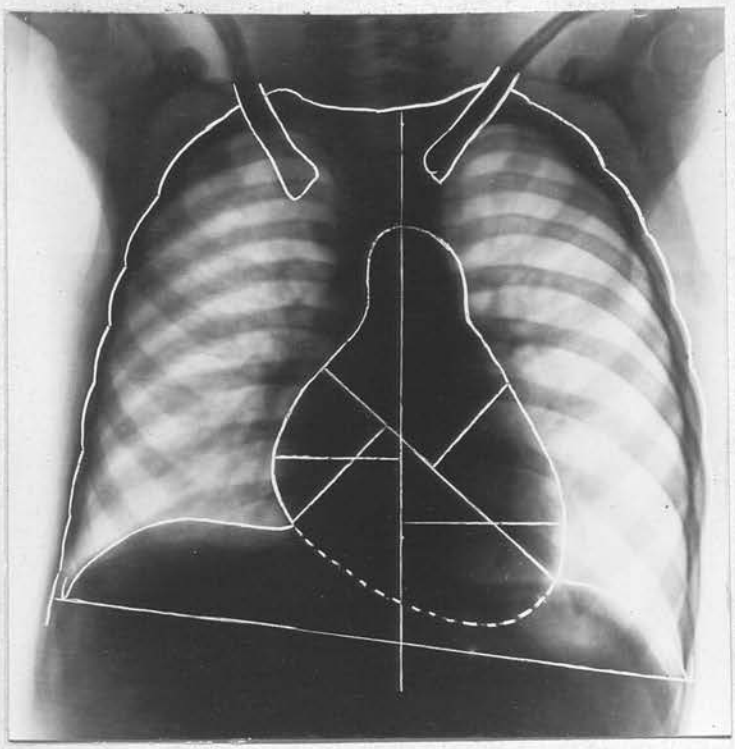
May. 28. Rheumatic. Mitral regurgitation.
M.C.L.$7\frac{1}{4}$ Left border $6\frac{3}{4}$

CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	11.0	9.3	87	.93 = .936%

Radiograph shows undue prominence of left auricular area.
Percentage area is rather high.



Case No.32. Male. 6 yrs.

Feb. 28. Rheumatic child. Heart slightly enlarged No valve lesion.
M.C.L.5¾ Apex 6 ¼
Recommended to rest.

Mar. 28. Systolic murmur and dilatation. Further rest.
M.C.L.5¾ Apex 7¼

Sept.28. No murmur present on this date.
M.C.L.6¼ Apex 6¼

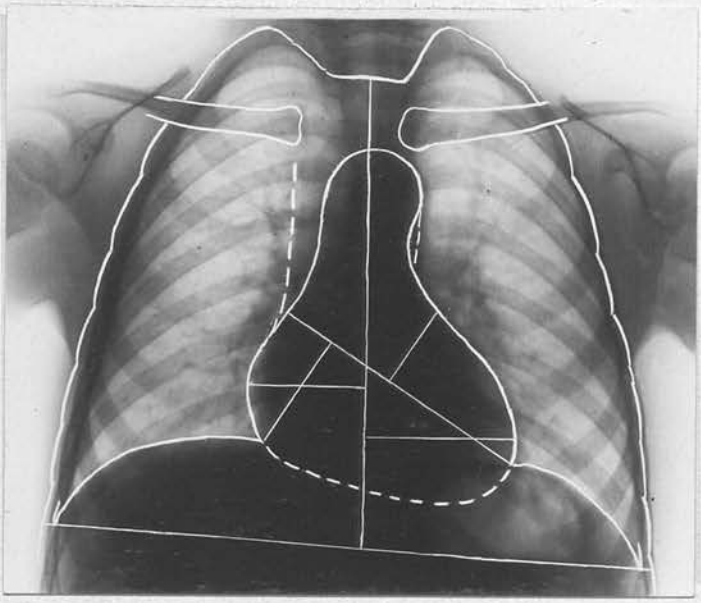
CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28	9.3	8.5	63	.82 = .768%
Sept.28.	10.1	9.3	75	.855= .877%

Radiograph shows in Feb. undue prominence of left auricle though percentage area is low. In Sept. the auricle is not so relatively prominent, and the percentage area has increased with age; though not increasing above normal limits.

The percentage area should decrease with age at this period, and the increase shown may indicate some definite cardiac embarrassment.



Case No.57. Female. 5½ yrs.

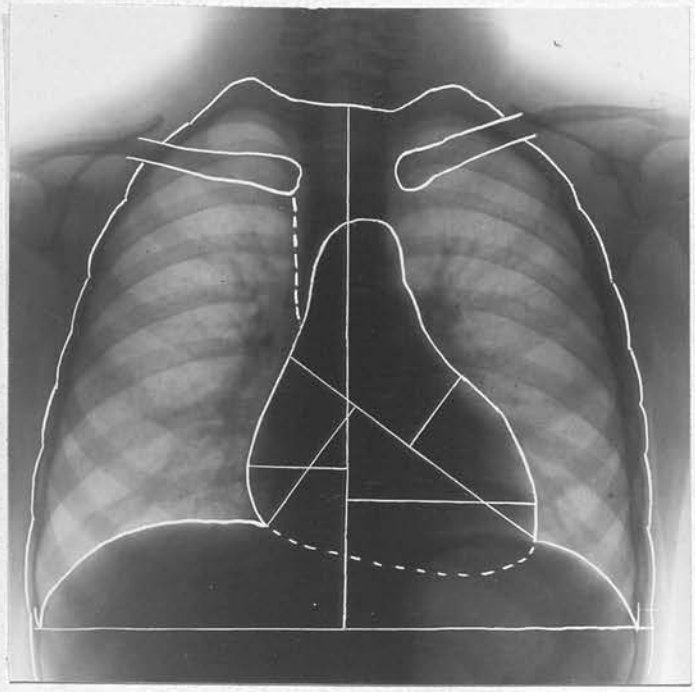
Oct. 28. Rheumatic child. Pulmonary systolic murmur, probably functional.
Normal heart.
M.C.L.6¼ Apex 6

CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Oct. 28.	8.7	8.6	57	.74 =.770%

Radiograph shows probably normal type of juvenile heart. No auricular bulge on left. The left ventricle may be somewhat enlarged, giving rise to the functional valve lesion. Note low percentage area of .77



Case No.56. Female. 5½ yrs.

Dec. 27. Doubtful rheumatic history. Late systolic murmur running into diastole. Possible mitral lesion.
M.C.L.6 Apex 6

May. 28. Mitral incompetence.
M.C.L.6¼ Left border 6

CLASS B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	10.0	9.7	64	.73 = .876%
May. 28.	10.0	9.2	66	.76 = .868%

Radiograph shows slight prominence of pulmonary arc, which may be developmental. Left ventricle somewhat enlarged, auricle not prominent. Lesion probably functional.

CLASS A1.

This class comprises twenty-five cases in which organic disease is present but not advanced.

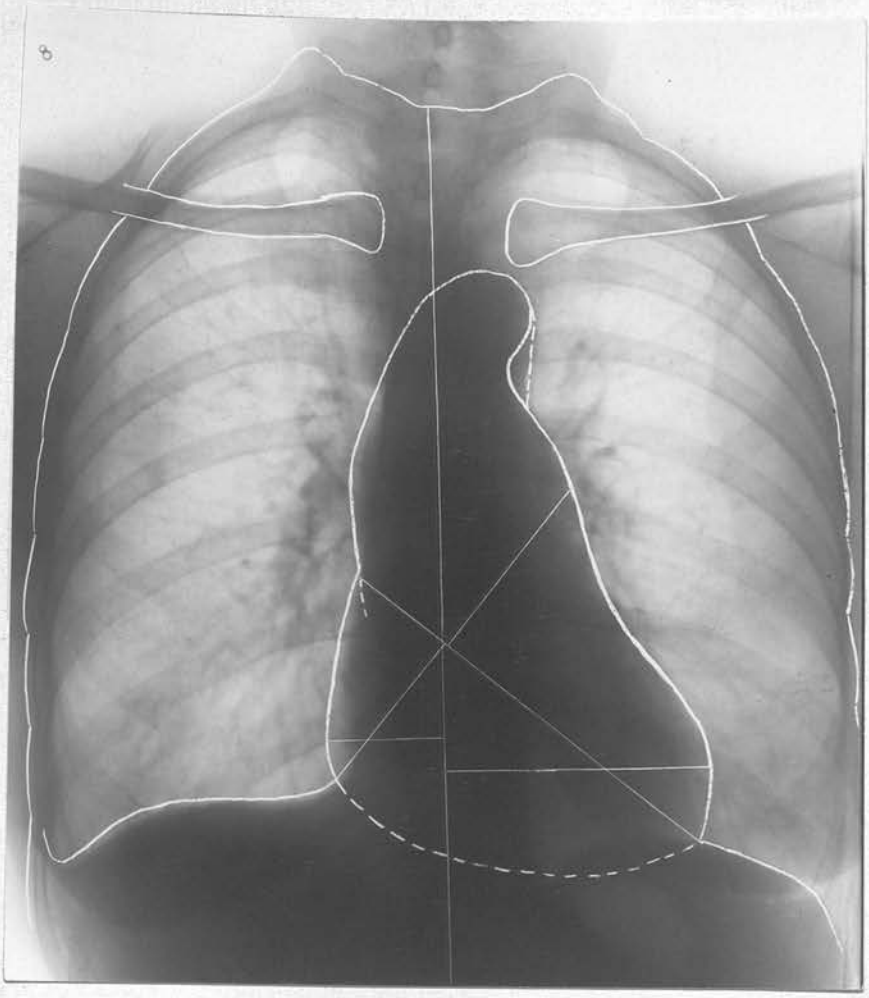
Case No.	Sex.	Age.	Ratio.	
95	F.	53 yrs.	.941%	
61	F.	24 "	.903%	(Dec.27)
			.916%	(June28)
106	M.	20 "	.857%	
50	F.	16 "	.810%	(Nov.27)
			.880%	(Jan.29)
15	F.	16 "	.800%	
81	F.	14 "	.798%	
89	M.	13 "	.911%	
52	M.	13 "	.778%	(Mar.28)
			.795%	(Jul.28)
			.829%	(Jan.29)
73	F.	13 "	.781%	
24	F.	13 "	1.150%	
16	F.	12 "	.869%	(Feb.28)
			.765%	(Oct.28)
29	M.	12 "	.809%	(May.28)
			.832%	(Jul.28)
28	M.	11 "	.787%	
47	M.	11 "	.916%	(May.28)
			.900%	(Nov.28)
48	F.	11 "	1.095%	(Feb.28)
			1.120%	(Oct.28)
40	F.	11 "	.921%	(Feb.28)
			1.040%	(Sep.28)
18	F.	10½"	.911%	
53	F.	9 "	.813%	(Mar.28)
			.833%	(Jul.28)
21	F.	9 "	1.050%	(Nov.28)
			1.130%	(Sep.28)
2	M.	9 "	.890%	(May.28)
			.786%	(Nov.28)
71	M.	9 "	.939%	
64	M.	9 "	.978%	
63	M.	9 "	1.013%	
4	M.	8 "	.891%	(Jan.29)
11	M.	7 "	1.030%	(Mar.28)
			1.010%	(Oct.28)

The lowest ratio obtaining in this class is .765% in a girl of 12 years of age, the highest being 1.150% in a girl of 13 years of age.

This/

This appears to be an abnormal disparity for two females of close ages,but on reference to the cases,the one (case no.16) showing the low ratio of .765% at a previous examination was .869% on later examination, there may thus have been some error in this case. The other girl showing the high ratio (case no.24) of 1.150% has a very abnormal heart with a marked difference between the diaphragm levels,other factors apparently being present in this case.

The average ratio for this class is .866%



Case No.95. Female. 53 yrs.

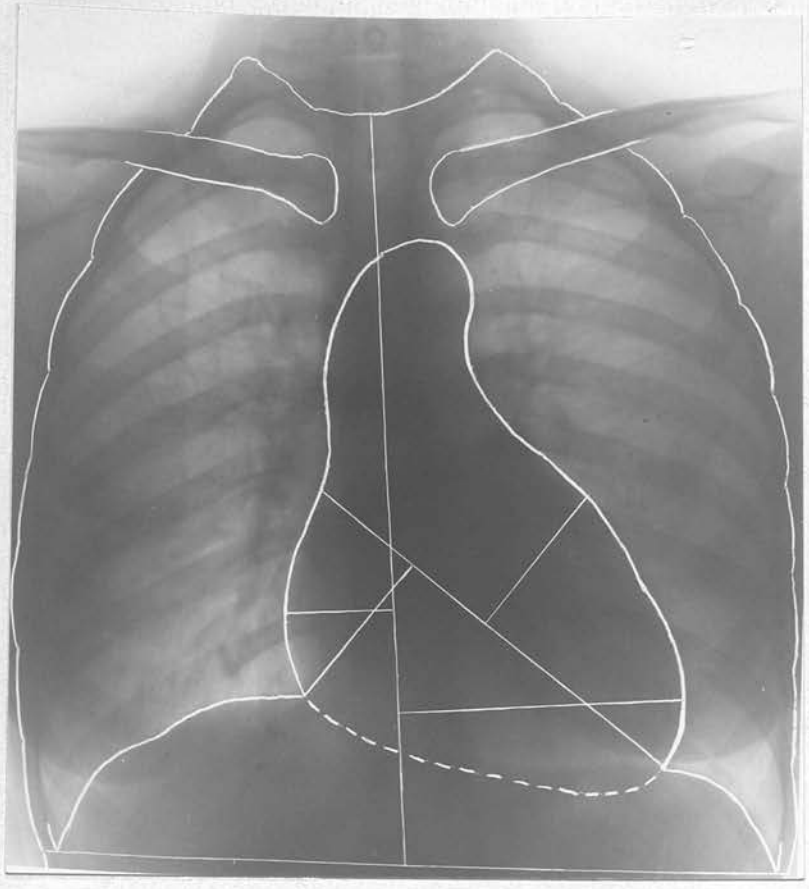
Nov. 28. Complete heart block. Ventricular rate28 auricular rate 76. Heart not enlarged. Arterio sclerotic heart disease. Wassermann negative.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Nov. 28.	13.9	12.3	152	1.615 = .941%

Radiograph shows diffuse dilatation of ascending aorta;also prominence of left auricle. Total heart area above normal,percentage area high.



Case No.61. Female. 24 yrs.

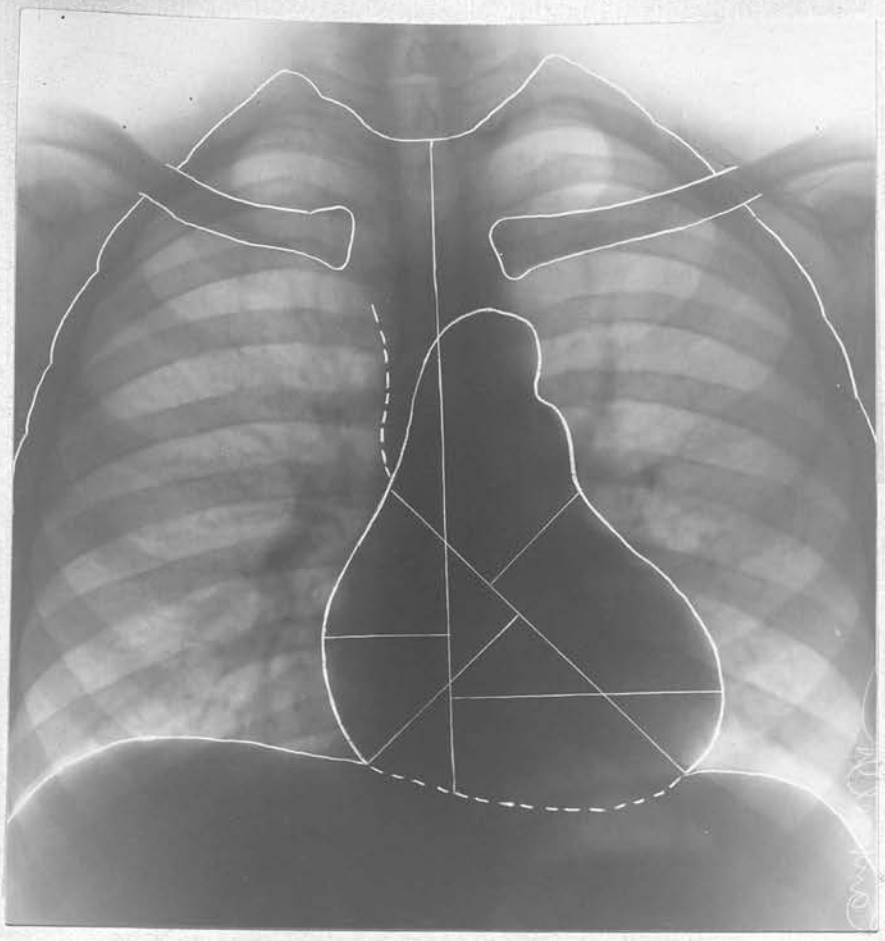
Dec. 27. Rheumatic fever followed by systolic murmur. Early stenosis and regurgitation.
M.C.L.9 Apex 10½

June.28. Apparently developing mitral stenosis.
M.C.L.9 Apex9

CLASS A1.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	13.5	12.3	140	1.55 = .903%
June.28.	14.2	12.6	143	1.565= .916%

Radiograph shows prominence of left auricle, confirming mitral disease.
Percentage area is high.



Case No.106. Male. 20 yrs.

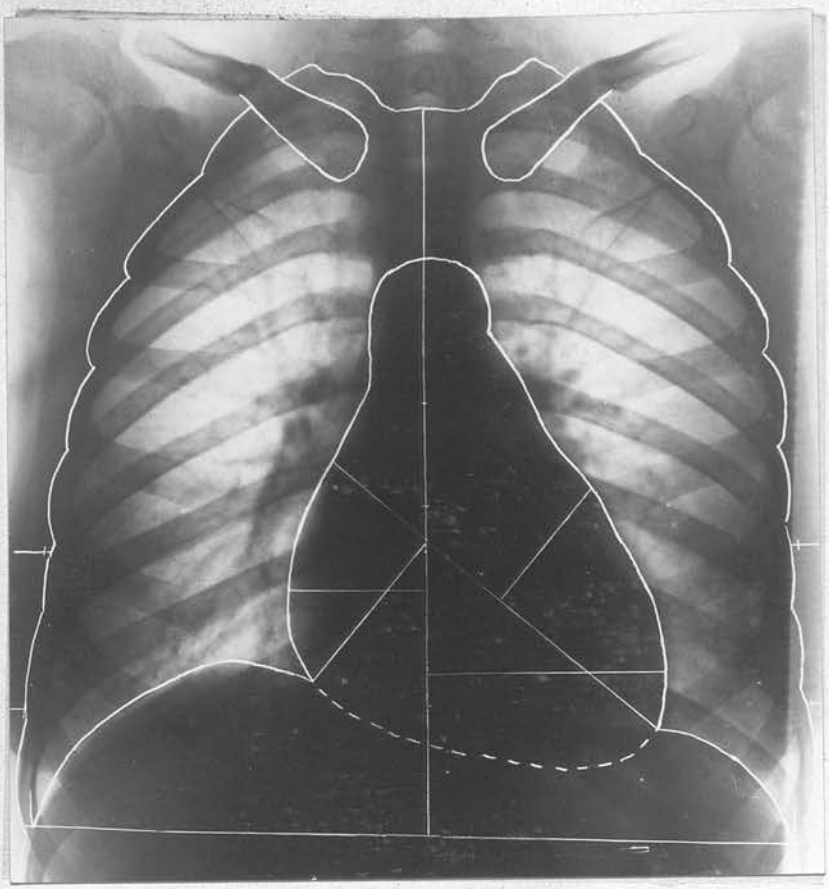
Mar. 28. Rheumatic history. Mitral stenosis with dilatation of pulmonary artery.
M.C.L.$9\frac{3}{4}$ Apex $9\frac{1}{4}$ in 5th space.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	13.2	12.7	132	1.54 = .857%

Radiograph shows definite dilatation of pulmonary artery. The left auricle is not relatively prominent. The apex is pushed upwards and outwards, suggesting hypertrophy of right ventricle.



Case No.50. Female. 16 yrs.

Nov. 27. Rheumatic. Old pericarditis. Now mitral regurgitation. No evidence of stenosis Aortic valves clear.
M.C.L.7 Apex 8

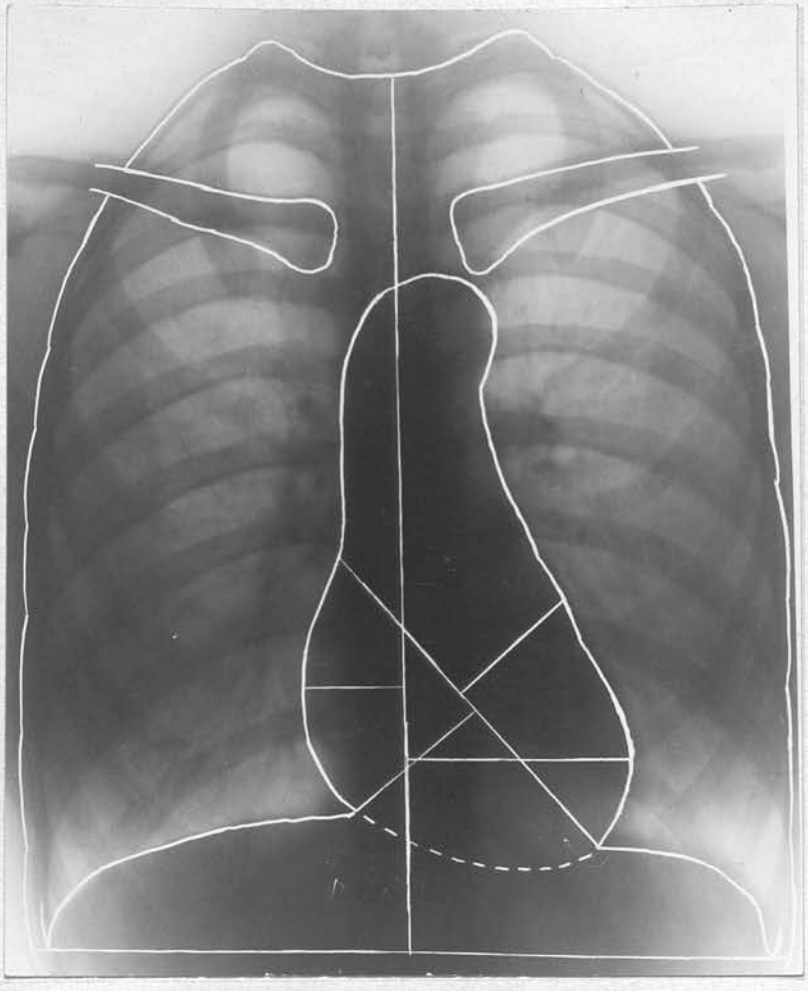
Jan. 29. Mitral disease. Has had rheumatic exaccerbation

CLASS A1.

Radiographic Measurement.

	L.D.	T.D.	H.A.	S.A.
Nov. 27.	12.8	11.8	119	1.47 = .81%
Jan. 29.	13.3	11.9	124	1.415 = .88%

No evidence pericarditis. B.S.A. decreased area of heart increased and auricle more prominent than previously.



Case No. 15. Female. 16 yrs.

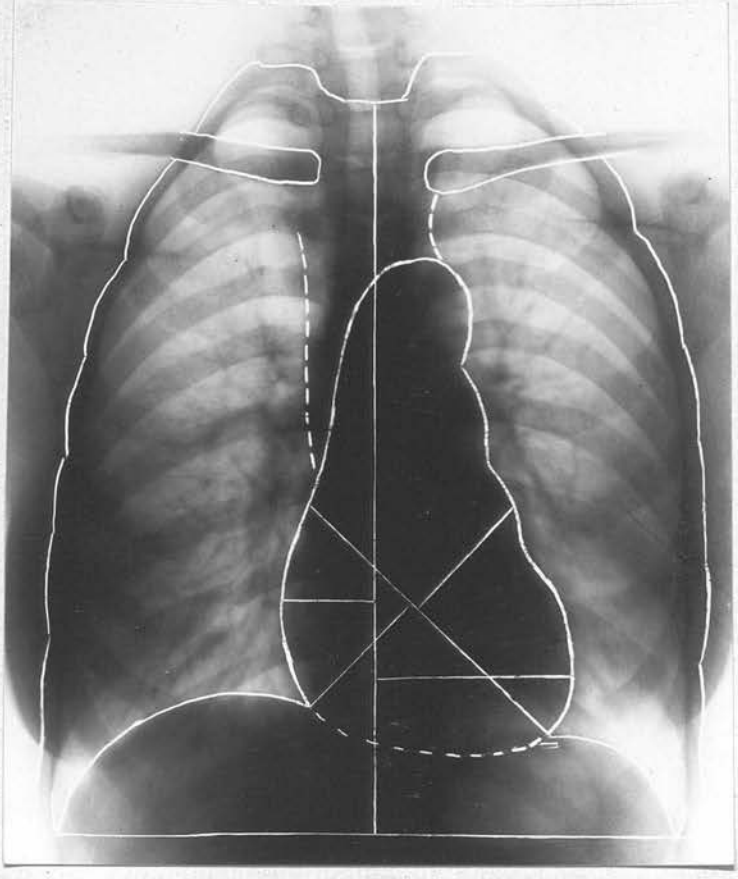
Jan. 29. Rheumatic history. Mitral regurgitation
Heart enlarged.
Apex .75cms beyond M.C.L. 6th rib.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Jan. 29.	12.5	10.3	127	1.58 = .80%

Radiograph shows slight prominence of left Auricle. Percentage area above normal.



Case No.81. Female. 14 yrs.

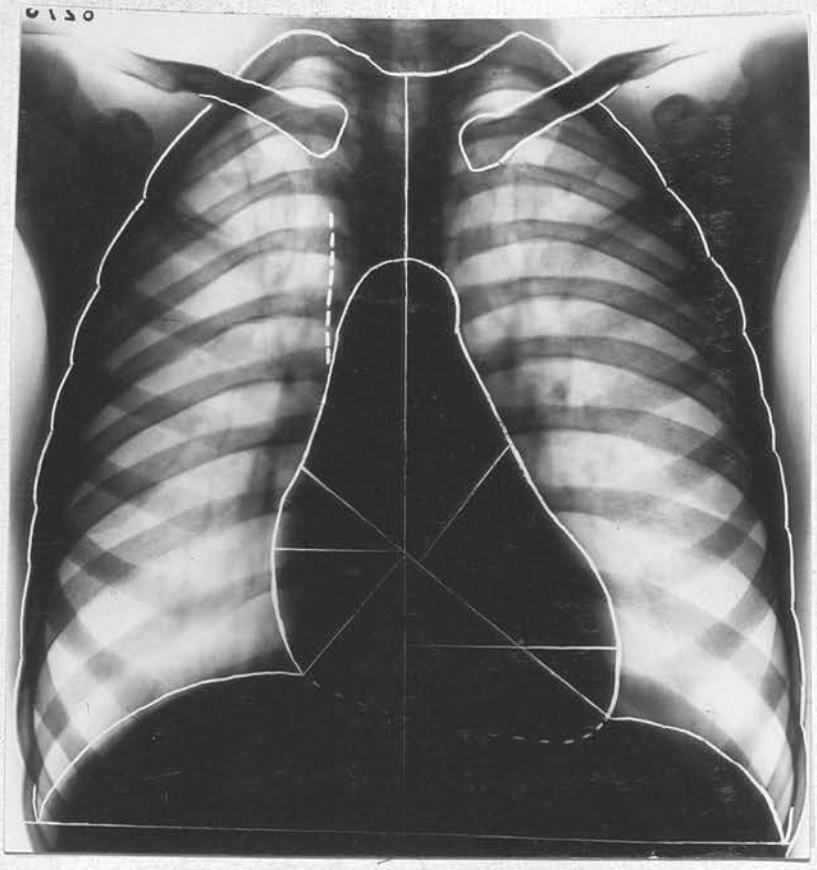
Jan. 28. Rheumatic history. Mitral disease.
M.C.L.$7\frac{3}{4}$ Apex $8\frac{1}{4}$

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Jan. 28.	10.7	9.4	99	1.24 = .798%

Radiograph suggests preponderance of stenosis, giving smaller heart than incompetence, and dilatation of pulmonary arch.



Case. No.89. Male. 13 yrs.

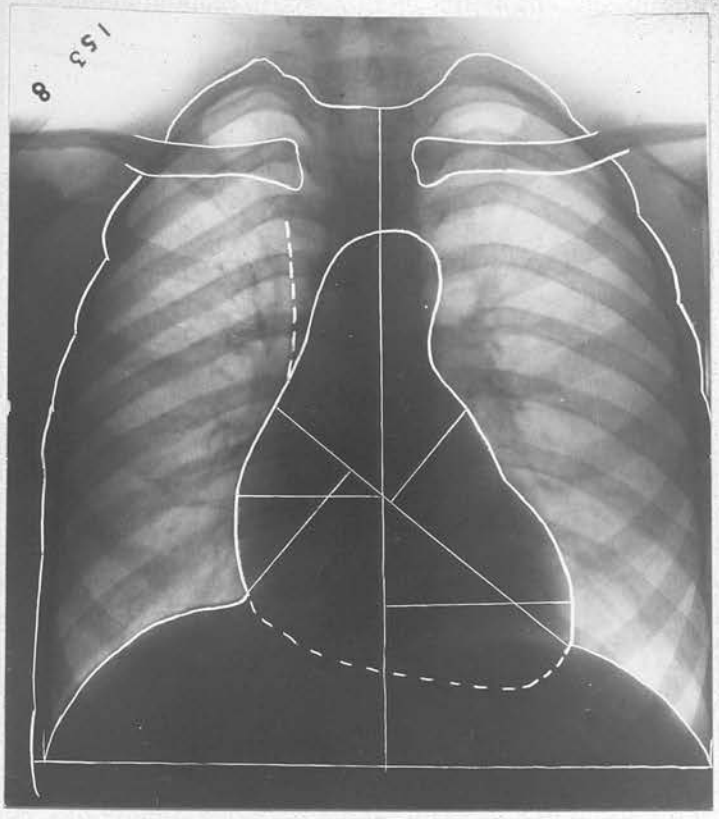
Sept.28. Rheumatic history. mitral regurgitation.
Apical systolic murmur.
M.C.L.8 Left border 8½

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Sept.28.	12.8	11.2	112	1.23 = .911%

Radiograph does not show any pronounced abnormality, but total cardiac area is large and percentage area is above normal.



Case No.52. Male. 13 yrs.

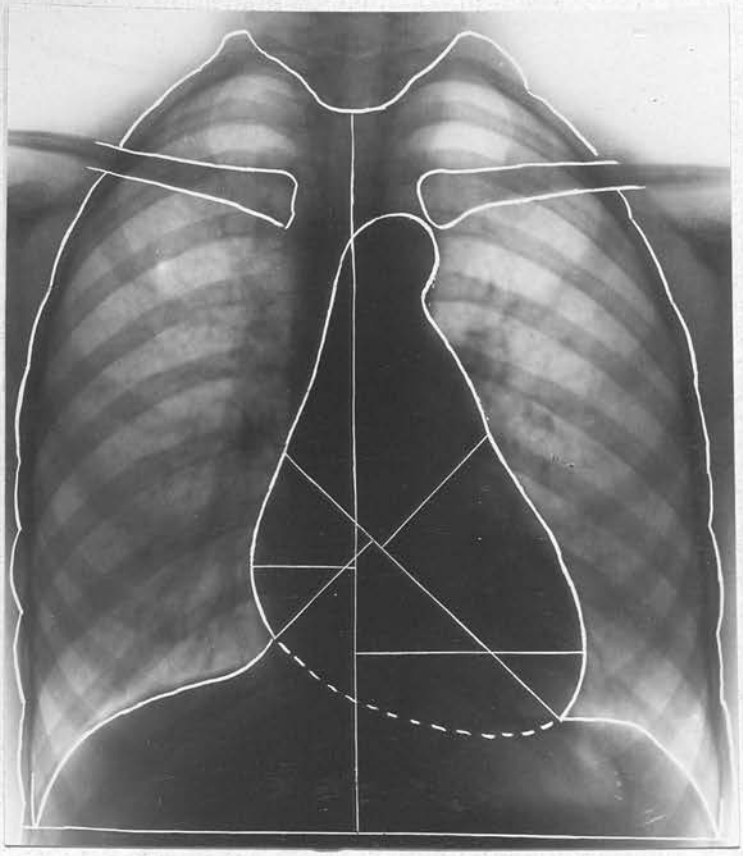
Mar. 28. Rheumatic mitral regurgitation. Said to have had pericarditis 5 years ago.
M.C.L.$7\frac{1}{2}$ Left border $8\frac{1}{2}$ in 5th space.
July.28. Heart appears a little smaller than formerly.
M.C.L.$7\frac{1}{2}$ Apex $7\frac{3}{4}$ in 5th space.
Jan. 29. M.C.L.$7\frac{1}{2}$ Apex 7

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	11.8	10.0	88	1.13 = .778%
July.28.	12.2	10.9	93	1.17 = .795%
Jan. 29.	12.3	10.7	101	1.225 = .829%

Radiograph illustrates well the auricular dilatation. the progressive rise in the percentage area is suggestive of an advancement of the cardiac embarrassment.



Case No.73. Female. 13 yrs.

Feb. 28. Rheumatic history. Early mitral stenosis and slight aortic regurgitation.
M.C.L.$7\frac{1}{2}$ Left border $7\frac{1}{2}$ in 5th space.

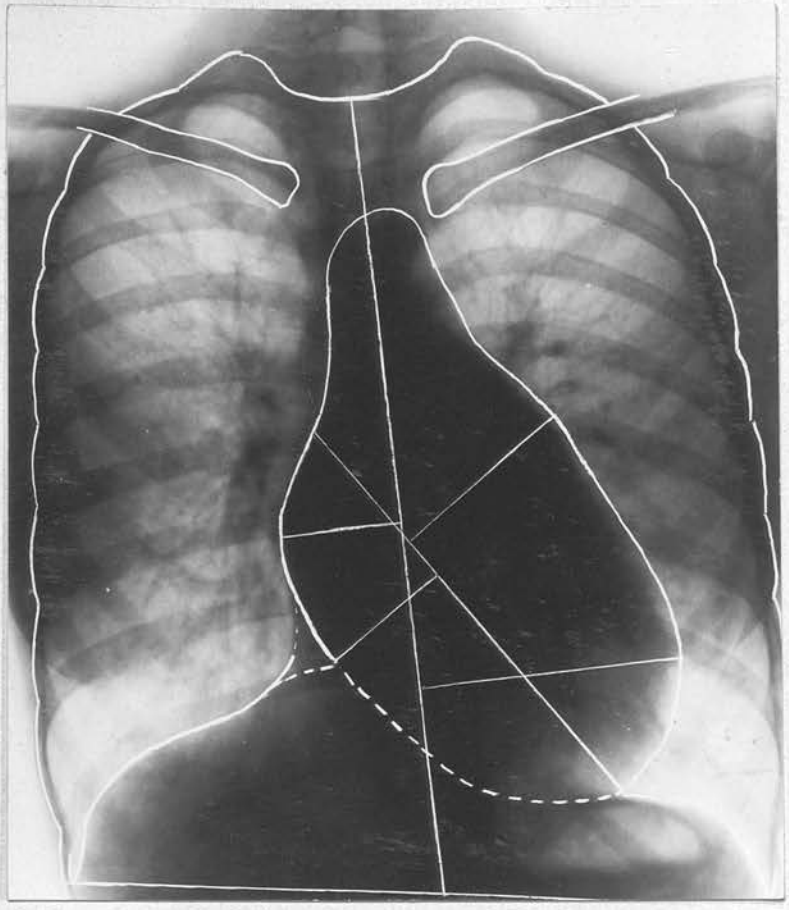
CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	12.3	10.7	111	1.42 = .781%

Radiograph shows slight prominence of left auricle.

Percentage area only slightly raised, but confirmatory of early mitral stenosis.



Case No.24. Female. 13 yrs.

Feb. 28. Rheumatic. Mitral regurgitation.
M.C.L.$8\frac{1}{4}$ Apex 10 in 5th space.

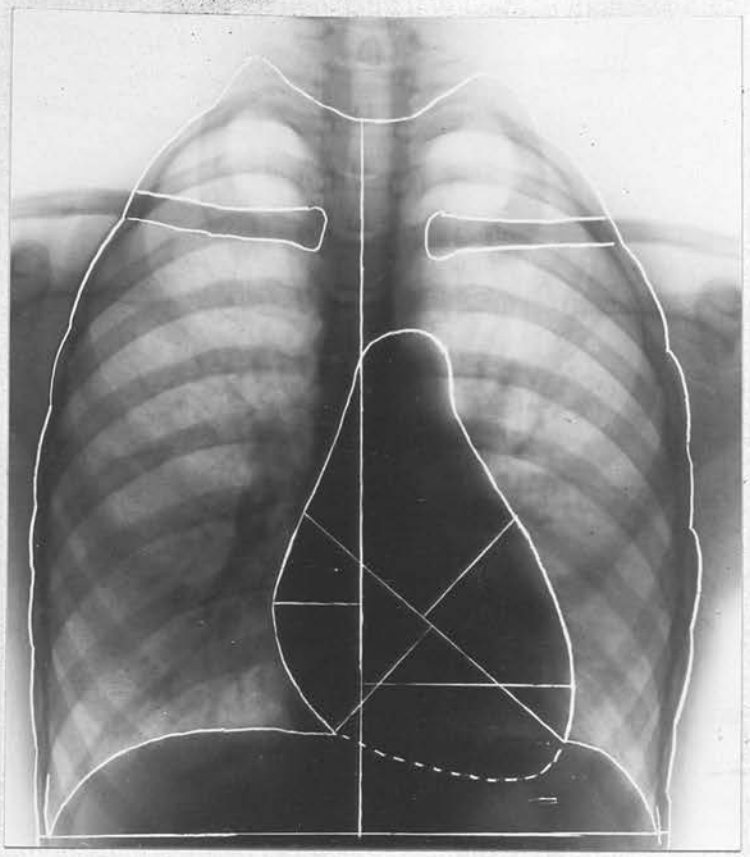
CLASS A1.

Radiographic Measurement.

	L.D.	T.D.	H.A.	S.A.	
Feb. 28.	15.2	12.1	149	1.29	= 1.15%

Radiograph shows very abnormal type of heart. Left auricle is prominent, left ventricle enlarged--hypertrophic. The increase in the longitudinal diameter is suggestive of aortic incompetence.

Percentage area high.



Case No. 16. Female. 12 yrs.

Feb. 28. Rheumatic history. Mitral regurgitation.
M.C.L. 7. Apex 8½

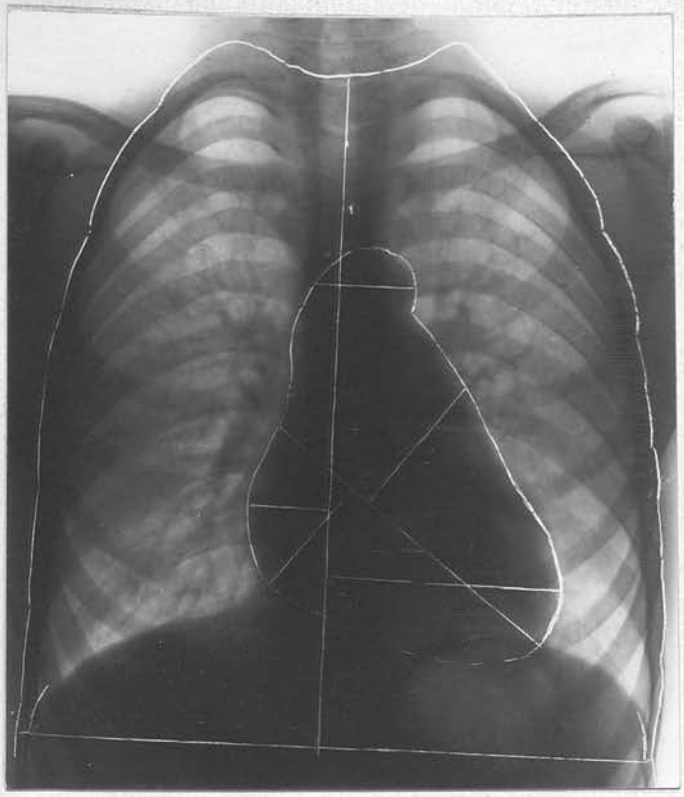
Oct. 28. Mitral disease apparently inactive.
clinically better, heart smaller.
M.C.L. 7½ Apex 8¼

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	10.5	9.2	93	1.07 = .869%
Oct. 28.	11.0	9.5	91	1.19 = .765%

Radiograph shows prominence of left Auricle. Although diameters are increased at second examination, the total area is decreased, and percentage area is lower, agreeing with clinical findings.



Case No.29. Male. 12 yrs.

May. 28. Rheumatic history. Cardiac hypertrophy with systolic murmur at apex. Possible mitral disease.
M.C.L.6½ Left border 7½

July.28. No murmur detected.
M.C.L.6½ Left border 6¾

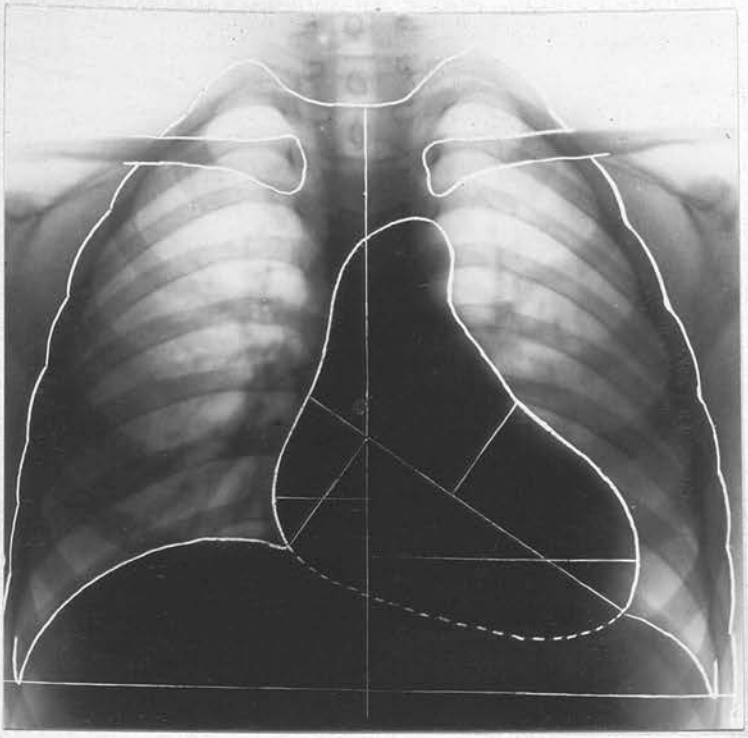
Dec. 28. Heart smaller. No murmur, but first mitral soft. Patient has improved though not gained in weight. May be developing a stenosis.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	10.1	9.3	82.5	1.02 = .809%
July.28.	10.4	9.4	84.0	1.01 = .832%
Dec. 28.	10.8	9.6	85.0	1.025= .829%

Radiograph shows enlargement of left auricular shadow, suggesting mitral disease. Percentage area above normal.



Case No.28. Male. 11 yrs.

Feb. 29. Mitral icompetence. Rheumatic history.
M.C.L.$7\frac{3}{4}$ Apex $8\frac{1}{4}$ in 5th space.
Patient appears over weight.

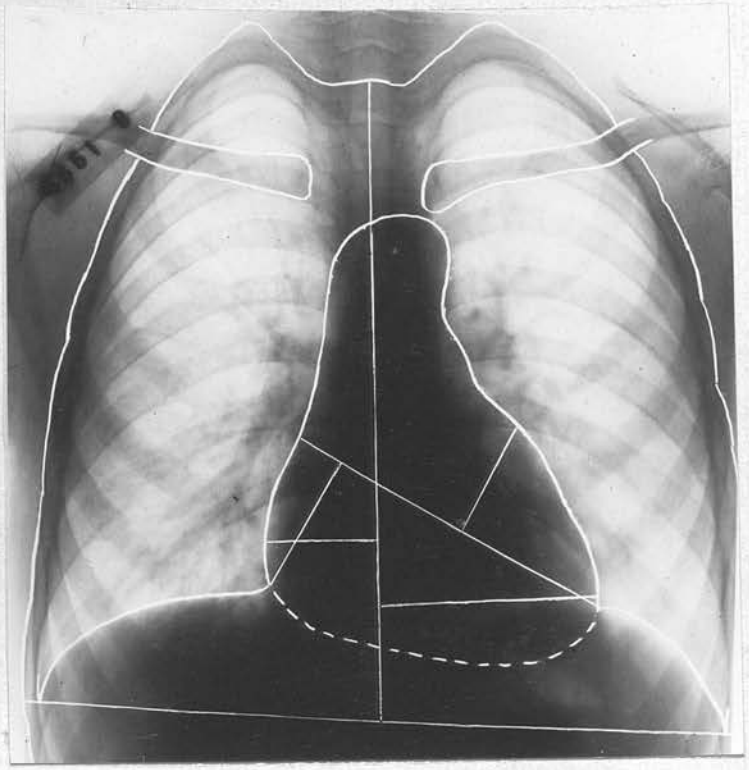
CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 29.	12.3	11.6	96	1.22 - .787%

Radiograph shows marked increase in longitudinal diameter suggestive of aortic leak. Left ventricle appears hypertrophied.

The percentage area is lower than expected, but the patient is apparently over weight, which reduces the percentage.



Case No.47. Male. 11 yrs.

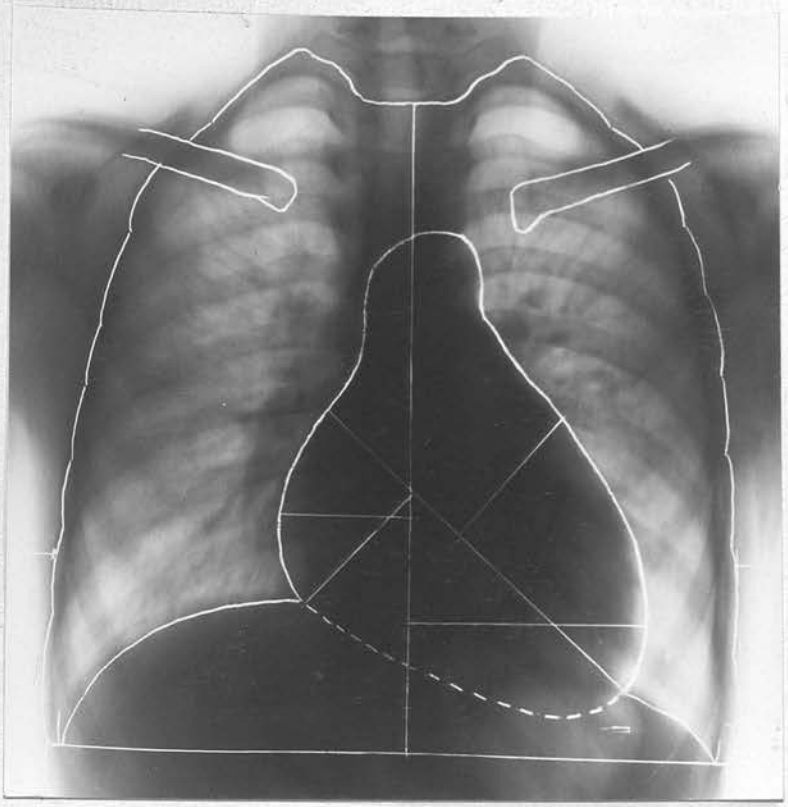
May. 28. Rheumatic history. Early mitral regurgitation.
M.C.L.$7\frac{1}{4}$ Left border $7\frac{1}{2}$
Nov. 28. Systolic murmur.
M.C.L.$7\frac{1}{2}$ Left border $7\frac{1}{2}$

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	11.7	10.8	98	1.07 = .916%
Nov. 28.	11.4	10.9	100	1.11 = .900%

Radiograph shows pronounced auricular enlargement.
Percentage area high.



Case No.48. Female. 11 yrs.

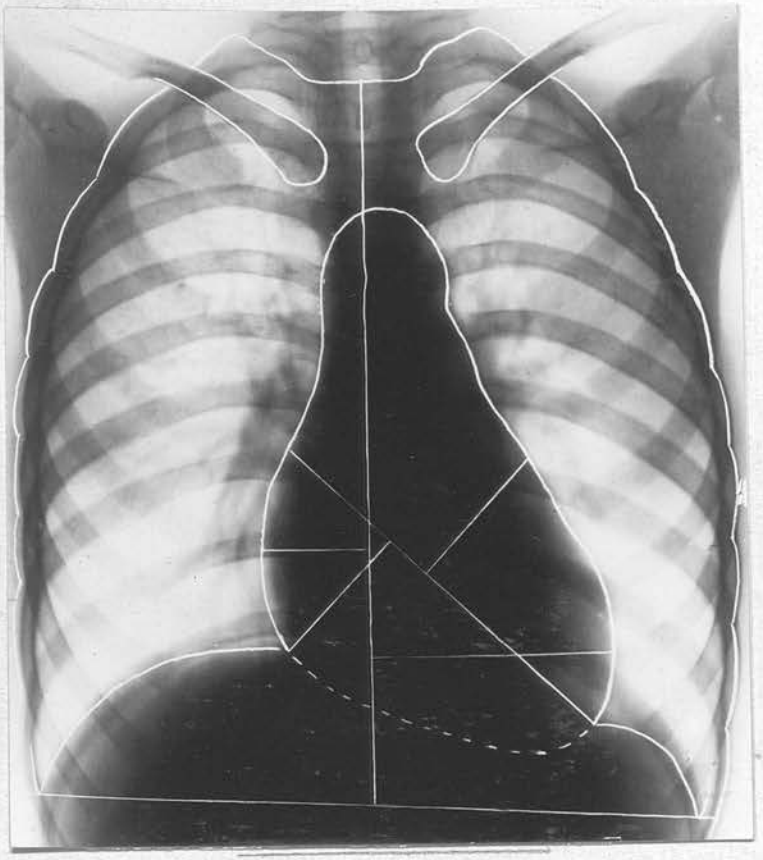
Feb. 28. Mitral regurgitation. Chorea.
M.C.L.7¾ Left border 8
Oct. 28. Possibly early stenosis.No aortic lesion.
Definite organic disease
M.C.L.7¾ Left border 9

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	13.2	11.8	115	1.05 = 1.095%
Oct. 28.	12.8	12.3	112	1.00 = 1.12%

Radiograph shows diffuse dilatation of left auricle.Left ventricle enlarged.Suggests regurgitation,more evident than stenosis
Percentage area high.



Case No.40. Female. 11 yrs.

Feb. 28. Rheumatic history. Early lesion. Aortic regurgitation. Mitral regurgitation.
M.C.L.$7\frac{1}{4}$ Apex $7\frac{3}{4}$

Sept.28. Aortic regurgitation predominant. Early stenosis of mitral valve.
M.C.L.$7\frac{3}{4}$ Apex $8\frac{1}{2}$ in 5th space.

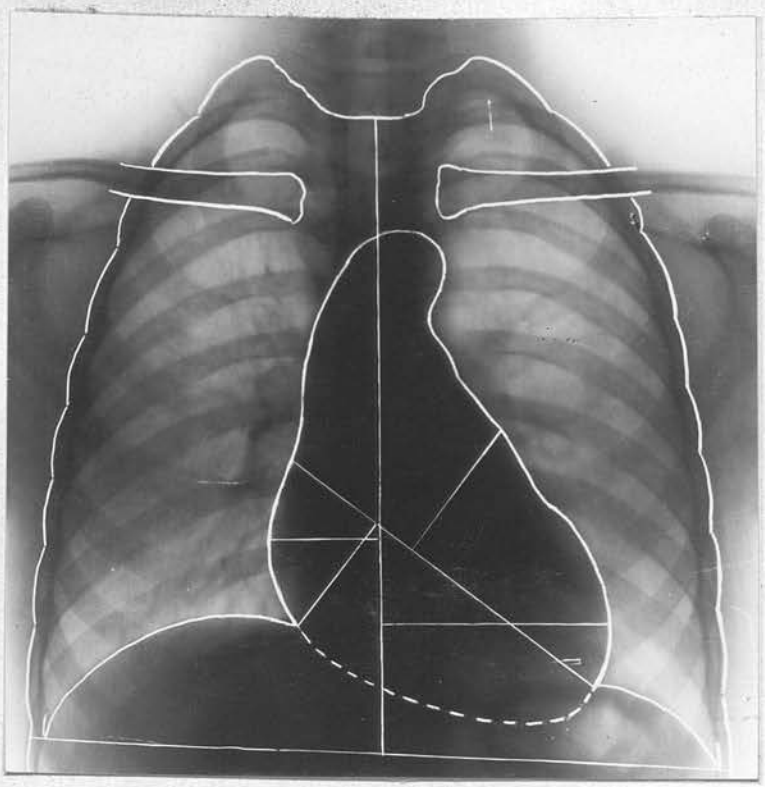
CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	13.0	7.6	104	1.13 = .921%
Sept.28.	13.2	11.3	126	1.21 =1.040%

Radiograph confirms predominence of aortic insufficiency, and presence of mitral lesion

Average percentage area of .98 high for age agreeing with class A1.



Case No. 18. Female. 10½ yrs.

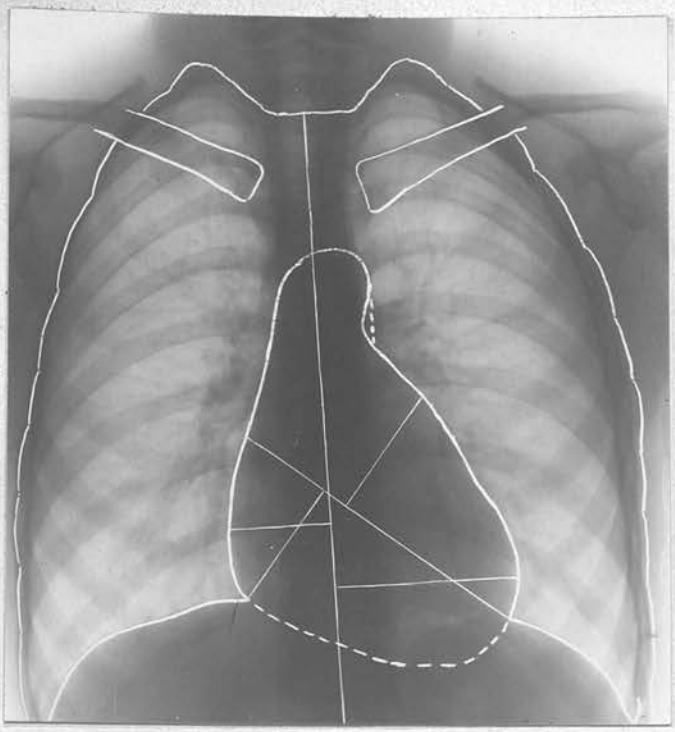
Feb. 28. Rheumatic history. Aortic regurgitation and probably Mitral regurgitation.
M.C.L. 7¾ Left border 9½ in 5th space.

GLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.	
Feb. 28.	12.2	10.9	107	1.175	=.911%

Radiograph shows prominence of left Auricle also enlargement of left Ventricle and notable increase in longitudinal diameter. Aortic regurgitation predominant. Percentage area high.



Case No.53. Female. 9 yrs.

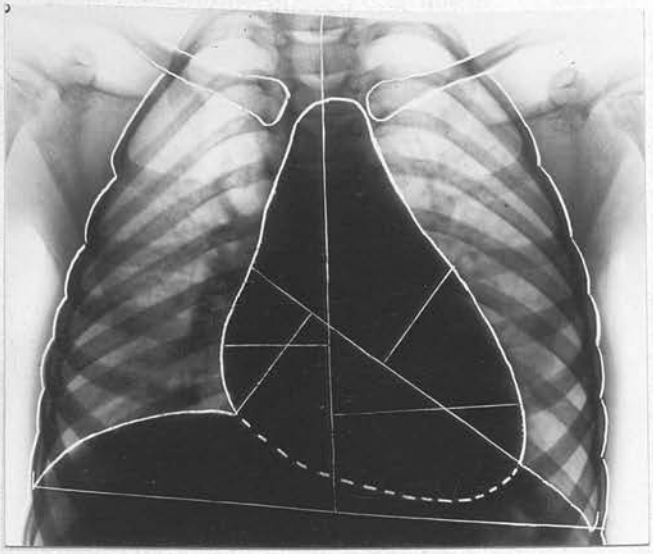
Mar. 28. Slight hypertrophy without evidence of valvular disease.
M.C.L.$6\frac{1}{4}$ Left border$7\frac{3}{4}$
July.28. Rheumatic child. Slight hypertrophy. No valve lesion detected.
M.C.L.$6\frac{1}{4}$ Left border$6\frac{1}{2}$
Dec. 28. M.C.L.$6\frac{1}{2}$ Left border$7\frac{1}{4}$
Idiopathic hypertrophy of heart.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.	
Mar. 28.	10.8	10.2	79	.95	= .831%
July.28.	10.4	9.3	80	.96	= .833%

Shows evidence of mitral disease which may not show clinically Either well compensated insufficiency or early stenosis.
Percentage area high.



Case No. 21. Female. 9 yrs.

Mar. 28. Rheumatic history. Mitral regurgitation inactive.

M.C.L.$6\frac{1}{2}$ L.B. $7\frac{3}{4}$

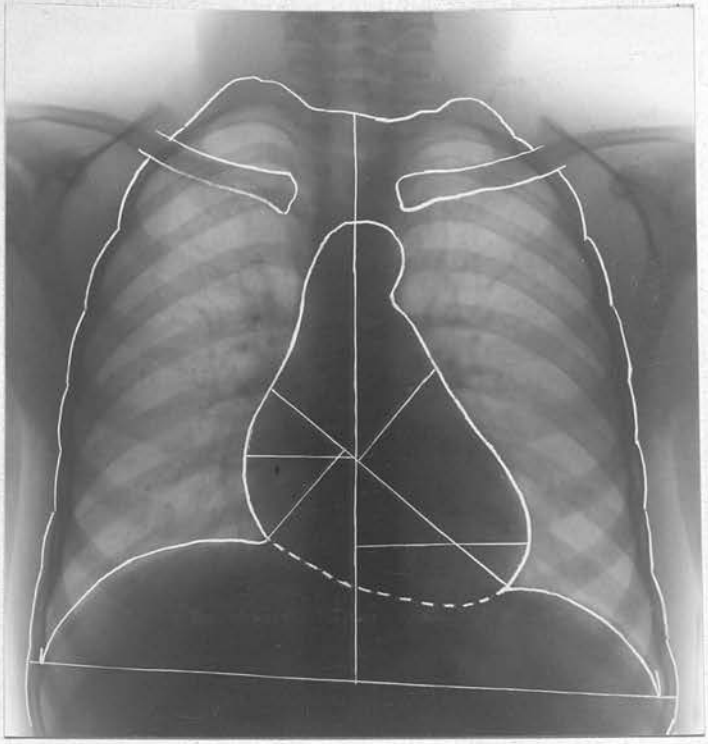
Sept.28. M.C.L.$6\frac{1}{2}$ Apex $7\frac{1}{2}$

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.		%
Mar. 28.	10.8	9.7	82	.775	=	1.05
Sept.28.	11.8	10.4	92	.81	=	1.13

Radiograph shows increased left auricular shadow. Area of heart large for age. Percentage area high.



Case No. 2. Male. 9 yrs.

May. 28. Rheumatism. Chorea. Scarlet fever.
Left border 1cm beyond M.C.L. in 4th space.

Nov. 28. Heart clinically a little smaller.
Left border .25cm beyond M.C.L. in 5th space.
Organic disease present. Not advanced.

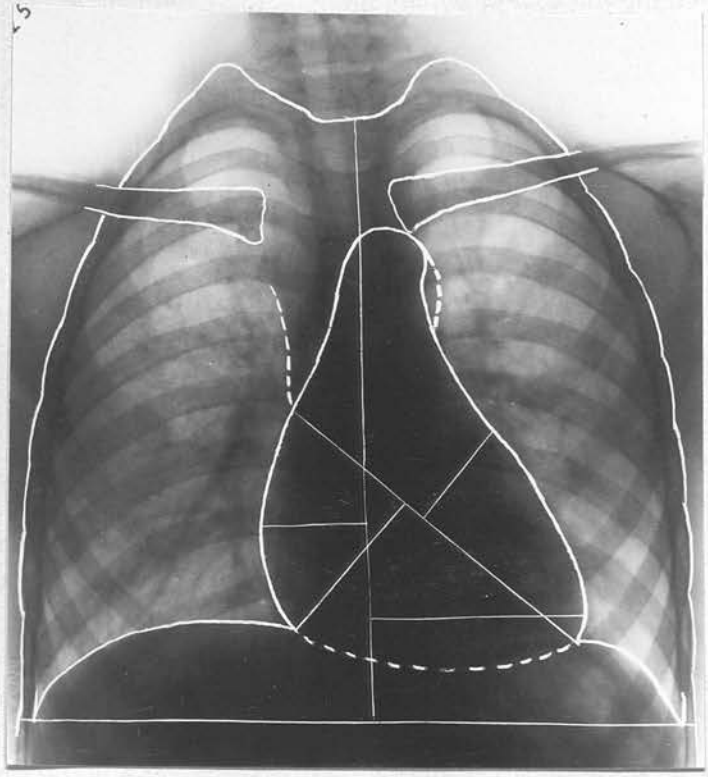
CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	11.0	9.8	80.5	.905 = .890%
Nov. 28.	10.2	9.2	72.9	.915 = .786 %

Radiograph shows slight prominence of left Auricular shadow. Heart area corresponds to clinical findings, while surface area of body increased by .01sq.m. Percentage area decreased by .104

.89 percentage area high for age.



Case No.71. Male. 9 yrs.

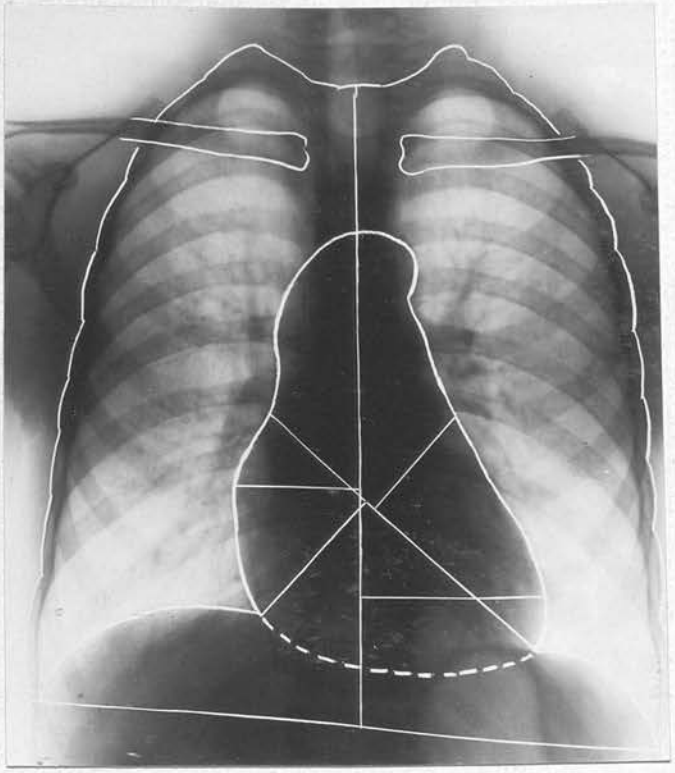
Nov. 28. Rheumatic carditis.Faint systolic murmur at apex.
M.C.L.$7\frac{1}{4}$ Left border $7\frac{1}{2}$

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Nov. 28.	11.1	10.4	93	.99 = .939%

Radiograph shows some general enlargement of heart, and slight prominence of left auricle
Percentage area high.



Case No.64. Male. 9 yrs.

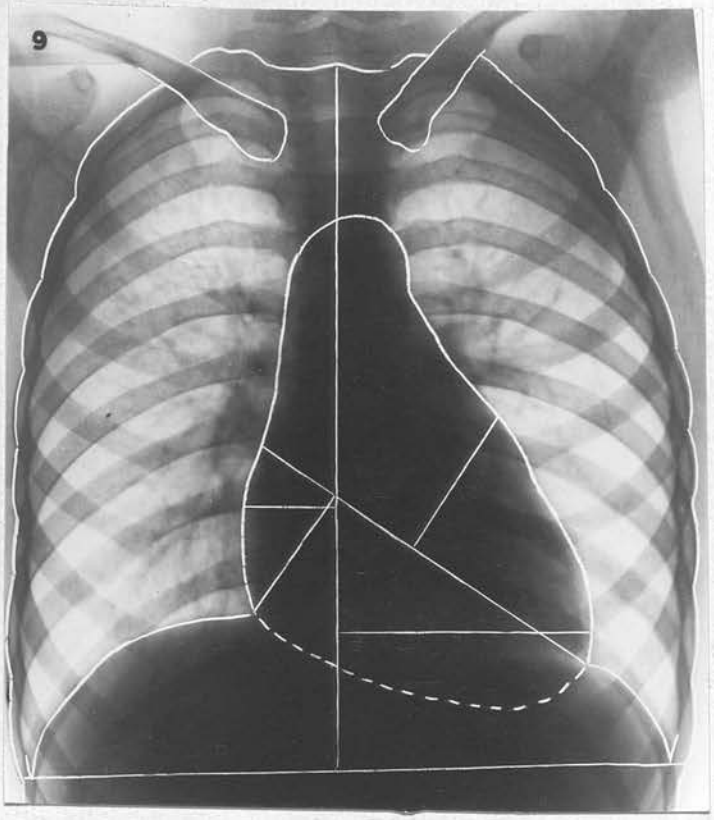
May. 28. Rheumatic history. Mitral regurgitation
Probably early mitral stenosis.
M.C.L.6½ Left border 6

CLASS A1.or B.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	11.3	10.0	93	.95 = .978%

Radiograph though not characteristic shows loss of usual concavity of left auricular area. The left ventricle appears relatively small. Suggestion of early mitral stenosis supported.



Case No.63. Male. 9 yrs.

Jan. 29. Rheumatic history. Mitral stenosis.
M.C.L.$6\frac{1}{2}$ Apex $6\frac{3}{4}$

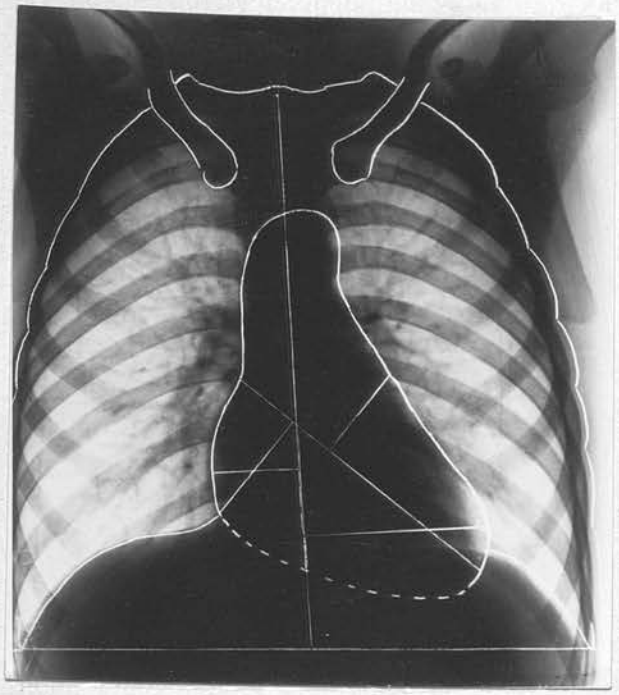
CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Jan. 29.	12.1	11.1	115	1.135 = 1.013%

Radiograph shows prominence of left auricle.

Percentage area high.



Case No.4. Male. 8 yrs.

Feb. 28. Rheumatic fever. Mitral incompetence
Potential heart disease.
Class C.

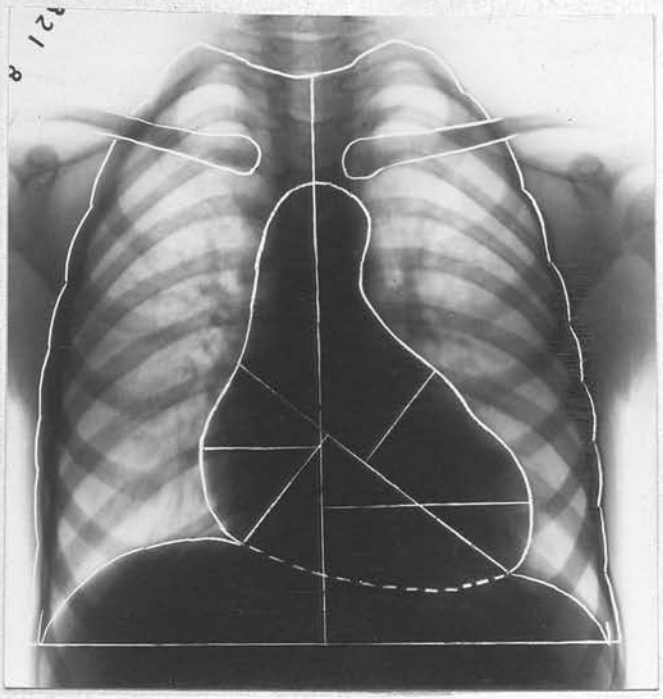
Jan. 29. Heart appears enlarged, but no murmur present on this date.
Apex .25cms outside M.C.L. in 5th space.
Class A1.

CLASS C and A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	10.1	9.1	74	.93 = .796%
Jan. 29.	11.5	10.2	90.5	1.01 = .891%

Radiograph shown taken in Jan. 29 does not present appearance of definite mitral lesion The longitudinal diameter has increased by 1.4cm. and the left ventricle suggests slight hypertrophy, indicating possible early organic lesion.



Case No. 11. Male. 7 yrs.

Mar. 28. Rheumatic history. Mitral disease--
possibly early stenosis.
Apex .25cms within M.C.L.

Oct. 28. Doubtful organic heart disease. Systolic at apex.
Apex coincides with M.C.L.

CLASS B. and A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.	
Mar. 28.	10.8	10.4	82	.79	= 1.03%
Oct. 28.	11.1	10.2	85.5	.84	= 1.01%

Radiograph shows undue prominence of left auricular shadow. Heart area large for age. Percentage area high. Probable early stenosis. Class B confirmed, at least, but classA1 is suggested

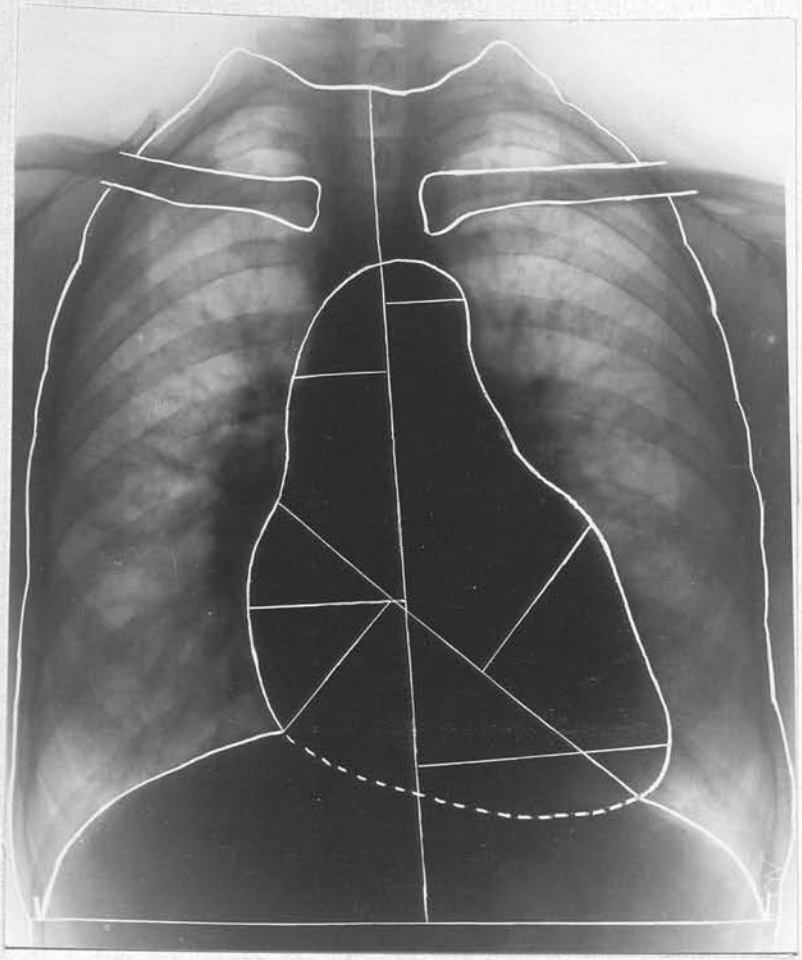
CLASS A2.

This group includes nine cases of advanced organic disease, the ability for physical exertion being diminished.

Case No.	Sex.	Age.	Ratio.
88	F.	47 yrs.	1.105% (Feb.28)
			1.225% (Feb.29)
79	F.	43 "	.908% (May.28)
		"	.857% (Oct.28)
19	M.	36 "	1.193%
33	F.	33 "	.950%
59	F.	25 "	1.140%
41	M.	18 "	1.050%
6	F.	14 "	1.530% (Feb.28)
			1.540% (May.28)
			1.470% (Jan.29)
92	F.	11 "	1.524%
75	F.	10 "	1.918% (Mar.28)
			1.943% (Nov.28)

The lowest ratio in this class is .857% in a woman of 43 years who gave a previous ratio of .908% The highest ratio is 1.943% in a girl of 10 years.

The average ratio for this class is 1.311%



Case No.88. Female. 47 yrs.

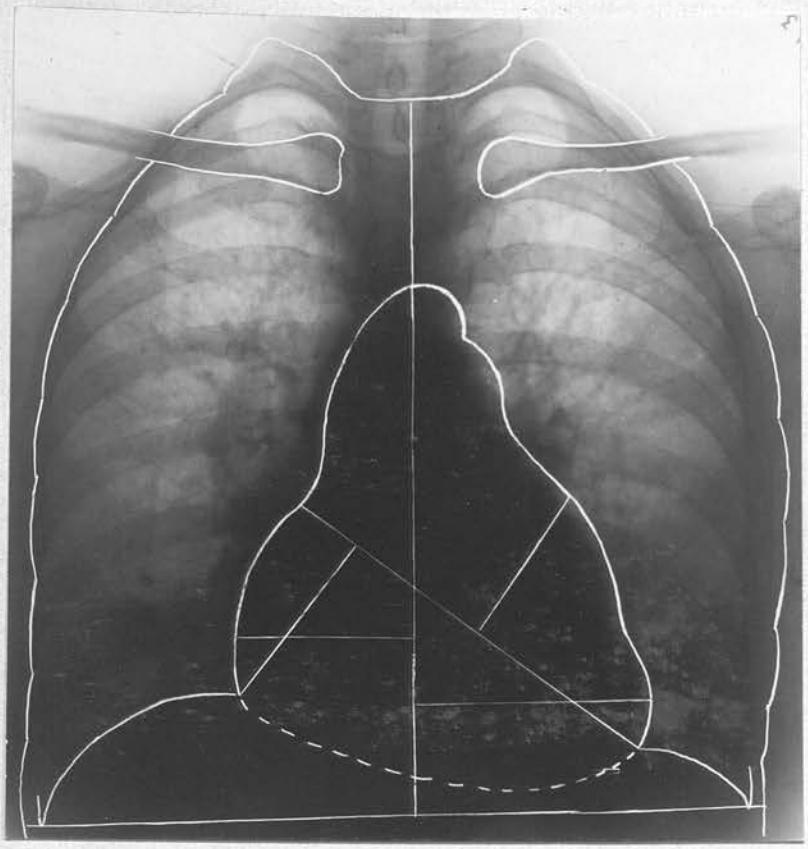
Feb. 28. Rheumatic heart disease.
M.C.L.9 Apex 10½ in 5th space.
Feb. 29. Aortic stenosis and mitral regurgitation.
Sharp systolic thrill at base.
M.C.L.9 Left border 10 at 7th rib.

CLASS A2

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	15.0	13.3	161	1.46 = 1.105%
Feb. 29.	16.0	14.4	176	1.435= 1.225%

Radiograph shows marked prominence of left auricular area, also increase in longitudinal diameter. Percentage area high.



Case No.79. Female. 43 yrs.

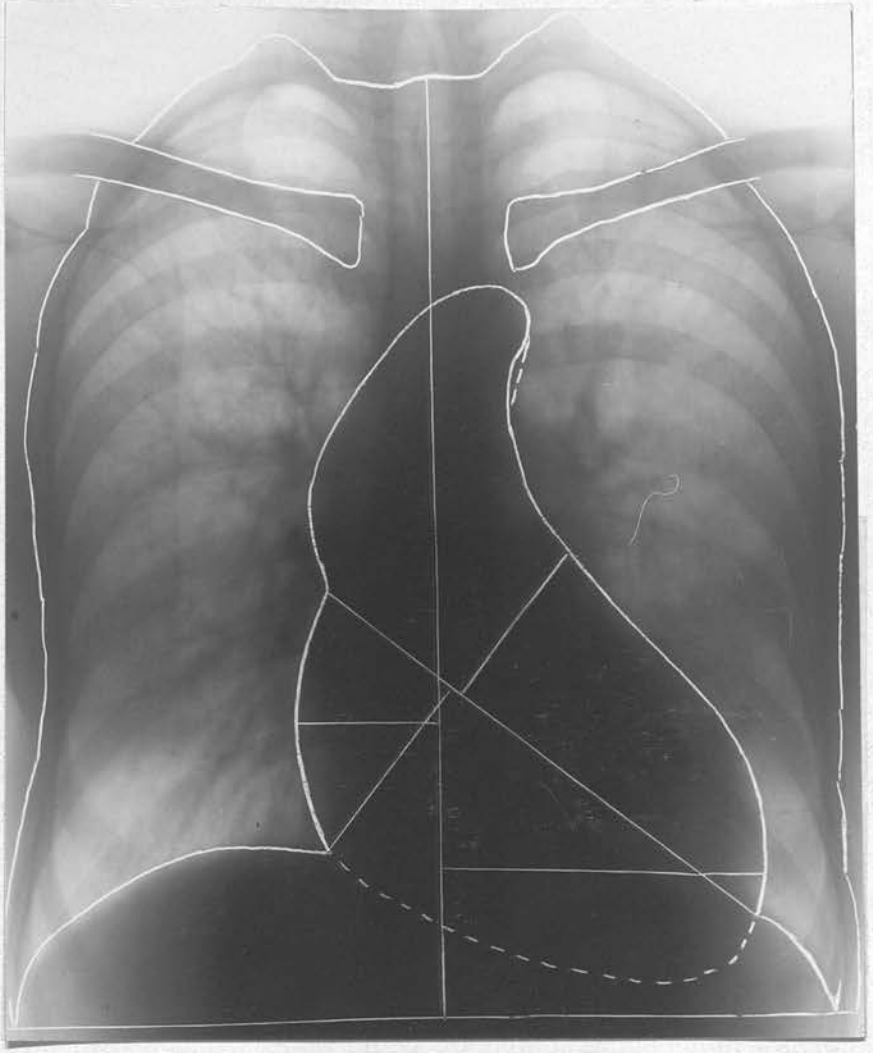
May. 28. Rheumatic history. Mitral disease.
Auricular fibrillation.
M.C.L.9 Left border 10
Oct. 28. Condition unchanged.

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	13.4	13.4	148	1.63 = .908%
Oct. 28.	13.6	13.2	138	1.61 = .857%

Radiograph shows marked diffuse enlargement of left auricle;pulmonary arch prominent.
Percentage area high.
Note pulmonary cogestion at bases of lungs.



Case. No.19. Male. 36 yrs.

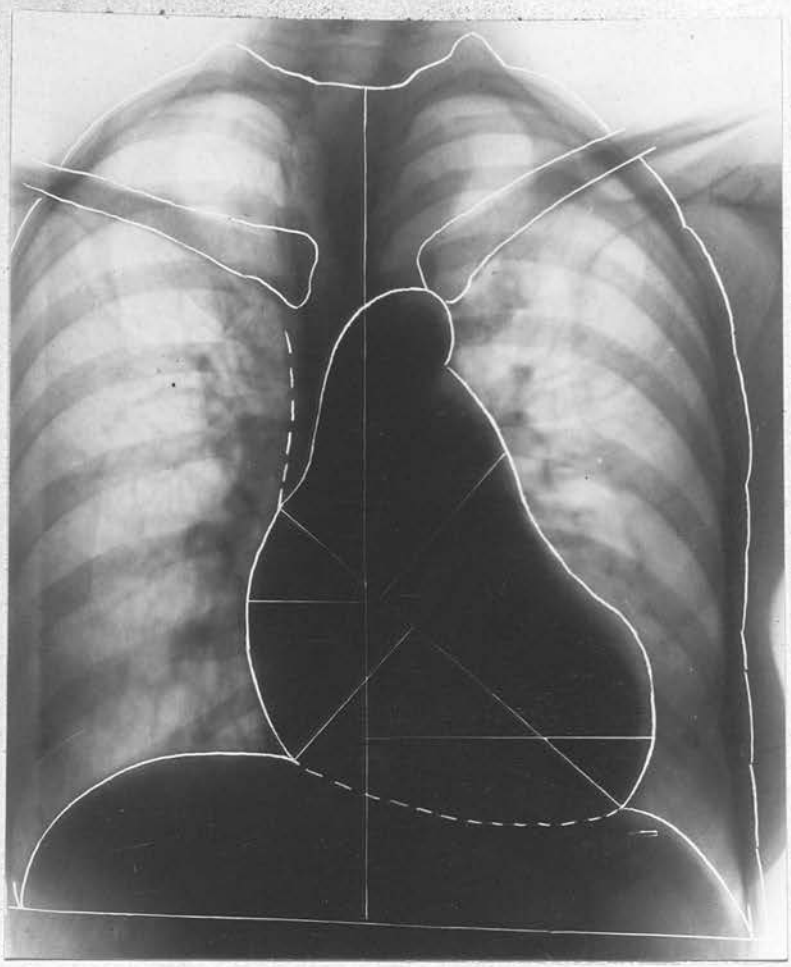
Dec. 27. Rheumatic history. Aortic and mitral regurgitation. Early aortic lesion.
Wassermann negative.
M.C.L.9 Apex 10

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	17.3	15.0	204.0	1.71 = 1.193%

Radiograph shows marked increase in longitudinal diameter, confirming aortic incompetence, also some diffuse dilatation of ascending aorta. The left auricle is not relatively prominent.



Case No.33. Female. 33 yrs.
Jan.28.

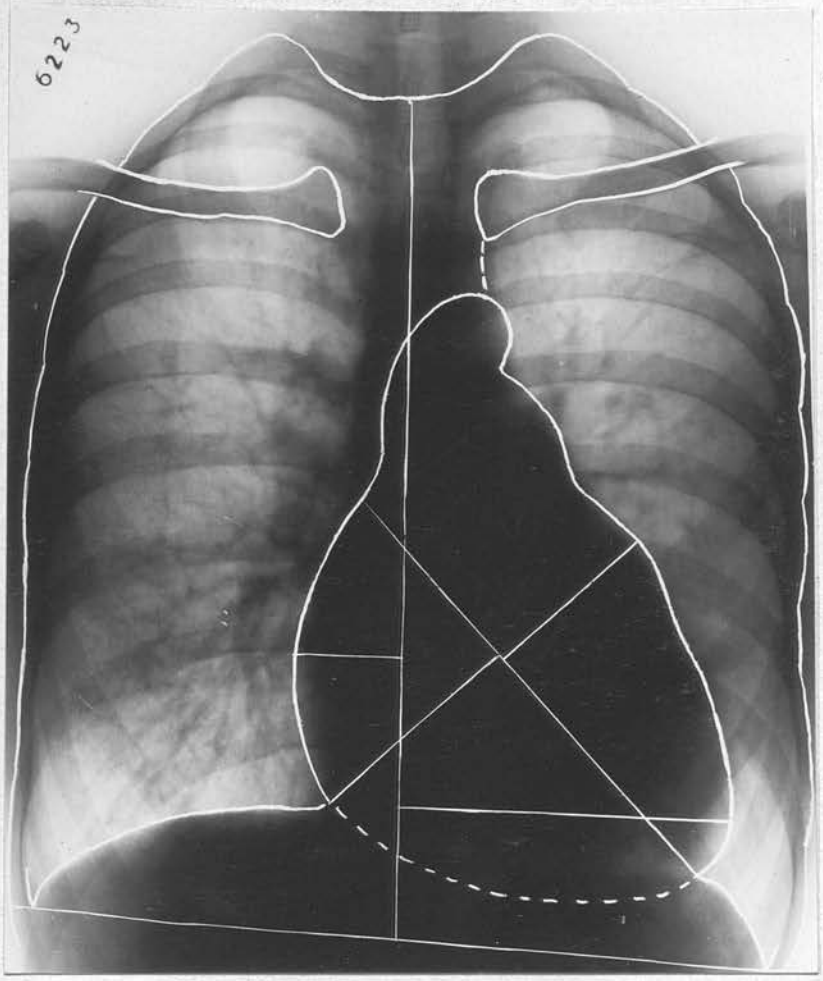
Rheumatic fever 1923. Adenoma of thyroid 1925. Mitral regurgitation now.
M.C.L.9 Left border 10½
Organic heart disease.

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Jan. 28.	14.6	13.0	144	1.52= .95%

Radiograph shows marked increase in left auricle, with hypertrophy of left ventricle. Mitral regurgitation indicated.
Percentage area high. Class A2 confirmed.



Case No.59. Female. 25 yrs.

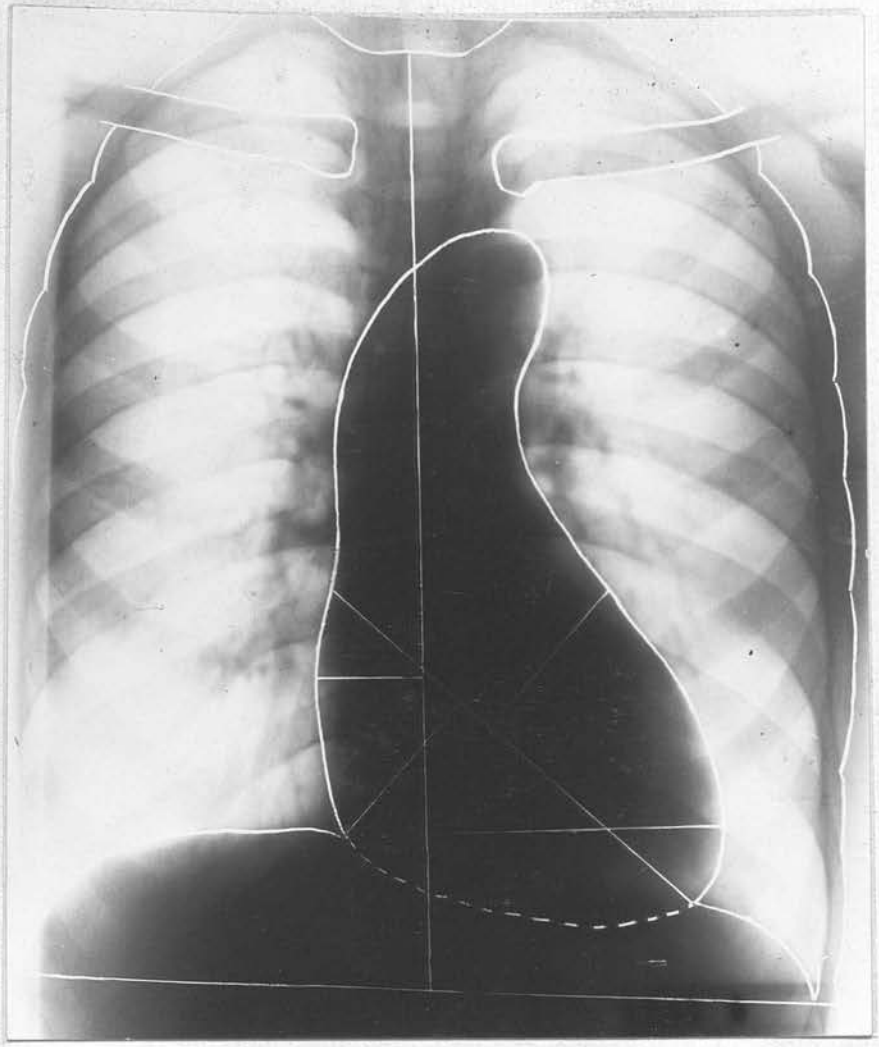
July.28. Old pericarditis. Mitral disease with dilatation of pulmonary artery;marked systolic pulsation in 2nd left space.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
July,28.	16.2	14.0	187	1.64 = 1.14%

Radiograph shows marked prominence of left auricle and pulmonary arch,and suggests predominance of mitral stenosis over incompetence, with resulting dilatation of pulmonary artery.
Percentage area high.

CLASS A 2.



Case No.41. Male. 18 yrs.

Feb. 28. Rheumatic injection at 13, now advanced aortic regurgitation and mitral leak.

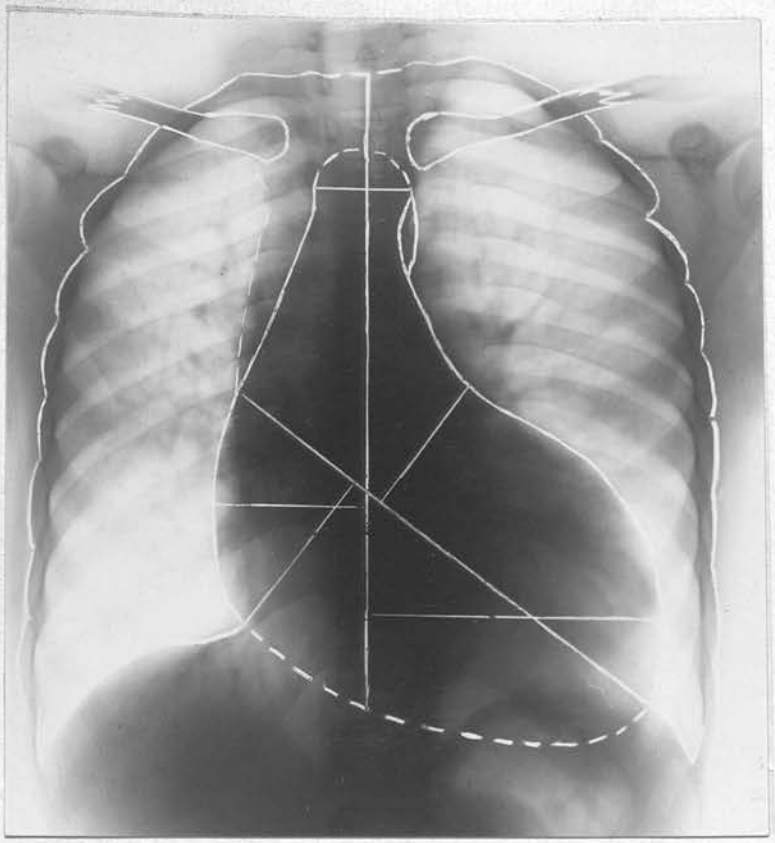
CLASS A2.

Radiographic Measurements.

Feb. 28.	L.D.	T.D.	H.A.	S.A.
	15.2	12.9	184	1.75 - 1.05%

Radiograph shows marked increase in longitudinal diameter, with slight relative increase in left auricle. Typical appearance of aortic regurgitation.

Percentage area high.



Case No.6 Female. 14 yrs.

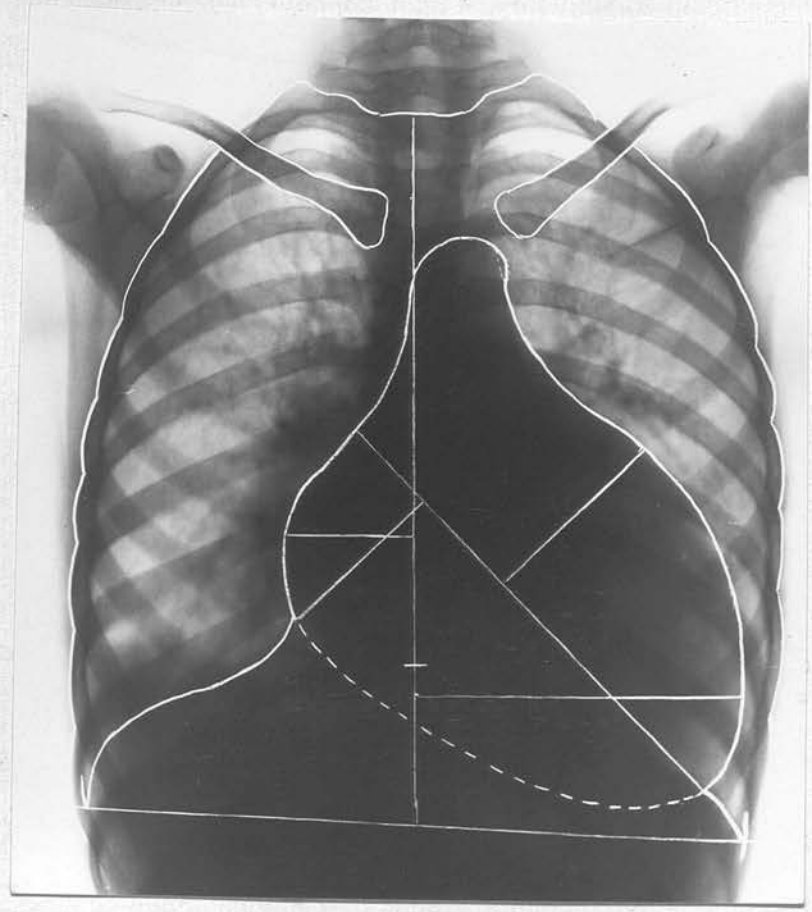
Feb. 28. Rheumatic history. Aortic regurgitation advanced. Mitral disease.
Left border 10½
May. 28. Left border 11
Jan. 29. Improved on strict therapeutic regime.
Left border 10½

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	17.00	14.9	172	1.12 - 1.53%
May. 28.	17.20	15.1	175.2	1.14 - 1.54%
Jan. 29.	17.30	15.5	169.5	1.19 = 1.47%

Radiograph shows that Aortic insufficiency predominates. The right heart is not enlarged and the left Auricle is not prominent. The Mitral lesion appears to be a relative insufficiency due to enlargement of left Ventricle. The percentage area is high.



Case No.92. Female. 11 yrs.

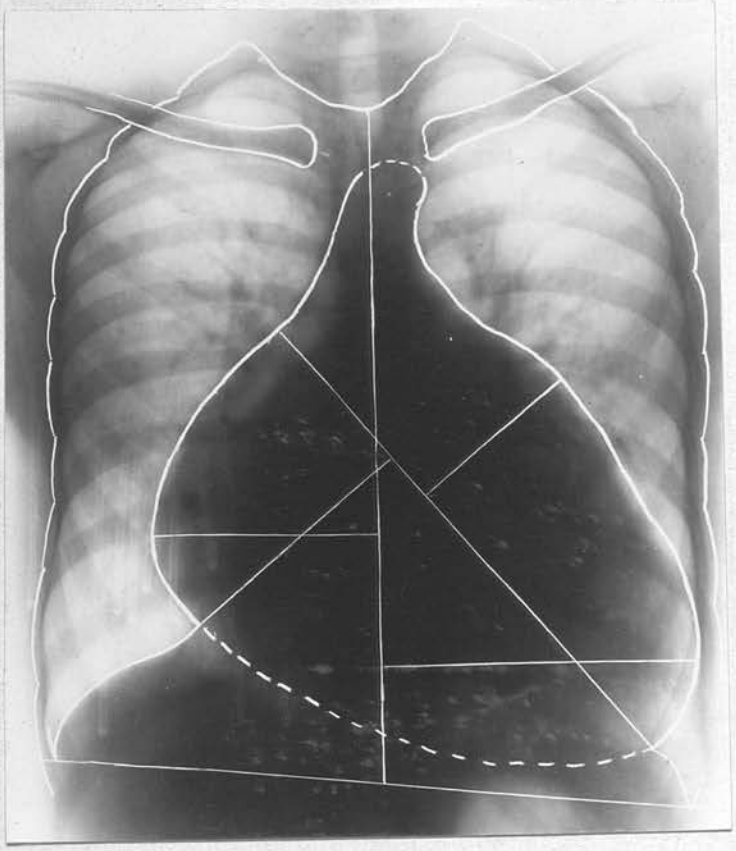
Feb. 28. Rheumatic mitral stenosis, and regurgitation
M.C.L.7 Apex 9½ in 6th space

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 28.	15.9	14.7	160	1.05 = 1.524%

Radiograph shows marked enlargement of heart, principally of left auricular area.
Percentage area high.



Case No.75. Female. 10 yrs.

Mar. 28. Adhesive pericarditis. Mitral incompetence.
M.C.L.7½ Apex 9 in 7th space.
Aug. 28. Condition unchanged.
Nov. 28. Indrawing of intercostal spaces.
M.C.L.7½ Apex 9½ in 7th space.
Pericarditis.

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	16.6	16.5	186	.97 = 1.918%
Nov. 28.	18.0	17.4	204	1.05 = 1.943%

Radiograph shows marked enlargement of heart.

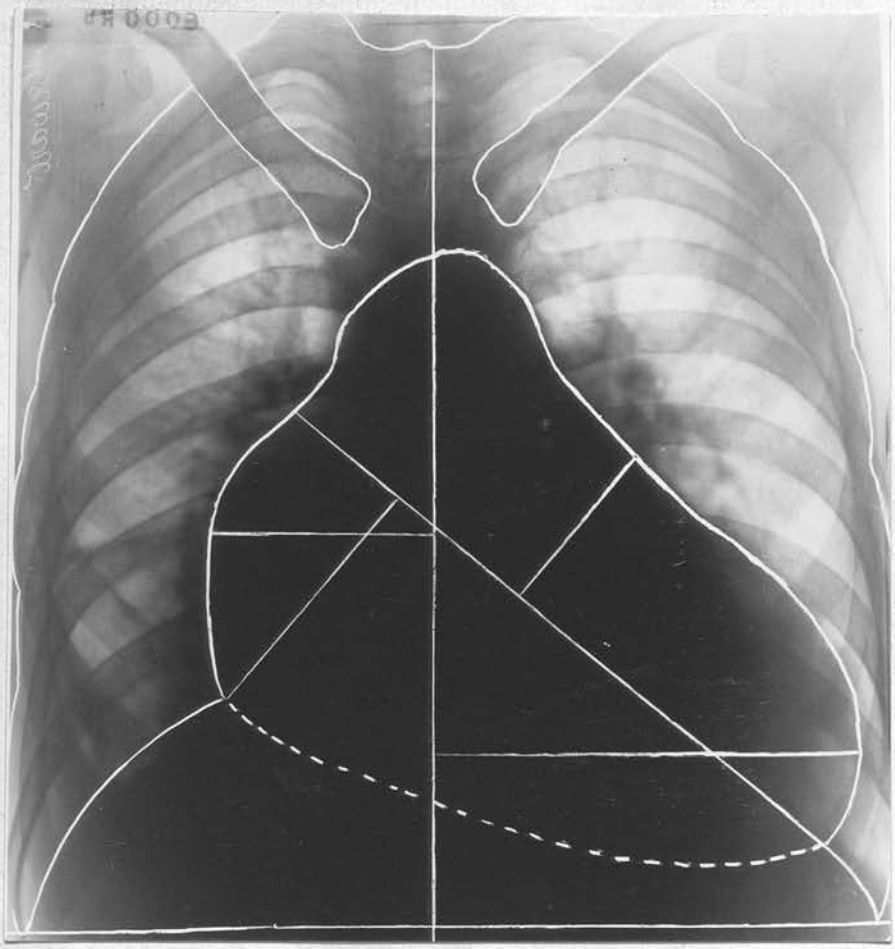
Percentage area very high.

CLASS A3.

This class comprises only three cases of advanced organic disease with signs of heart failure at rest.

Case No.	Sex.	Age.	Ratio.
91	M.	32 yrs.	1.550% (Nov.27)
			1.693% (Jul.28)
20	M.	40 "	1.650% (Jan.28)
			1.650% (Oct.28)
76	F.	26 "	1.640%

The average ratio for this class is 1.636%



Case No.91. Male. 32 yrs.

Nov. 27. Mitral stenosis. Auricular fibrillation. Rheumatic history.
July.28. Condition not so good. Some congestion. Died Oct. 28.

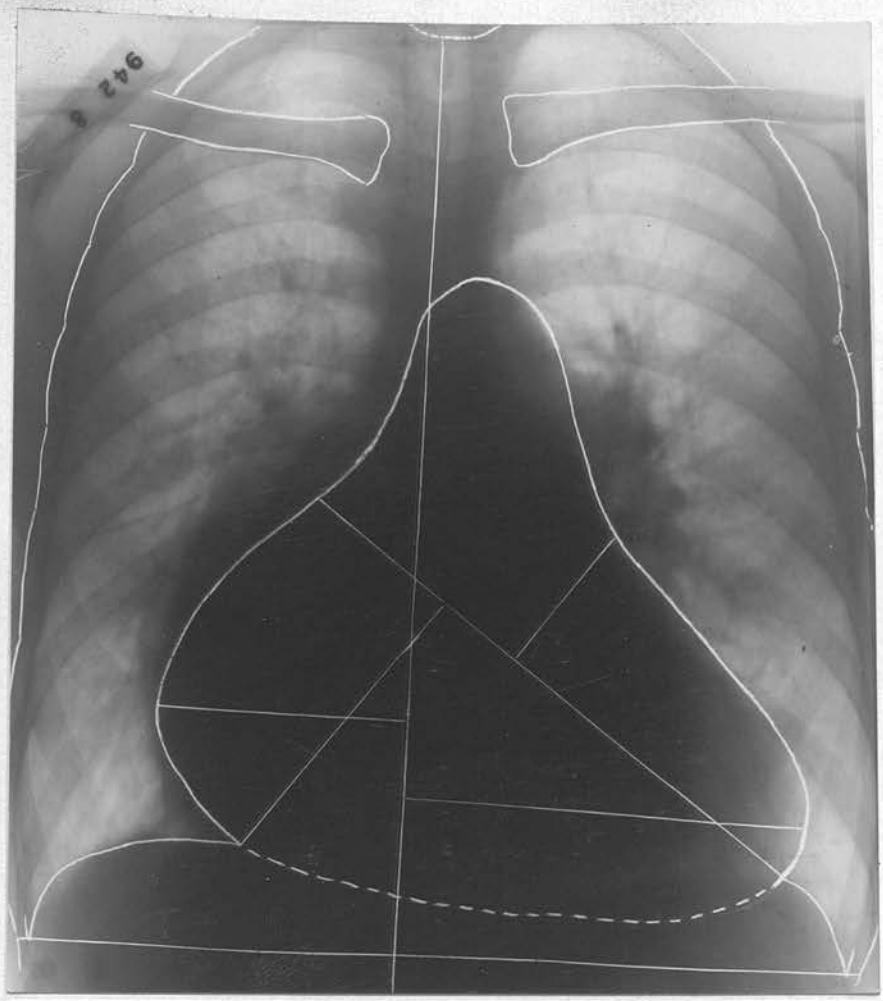
CLASS A3.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Nov. 27.	21.3	20.1	290	1.87 = 1.55%
July.28.	27.1	20.6	281	1.66 = 1.693%

Radiograph shows general enlargement of heart marked in right heart - evidence of congestion.

Percentage area high and showing increase with with progression of condition. Patient died in October 1928.



Case No. 20. Male 40 yrs.

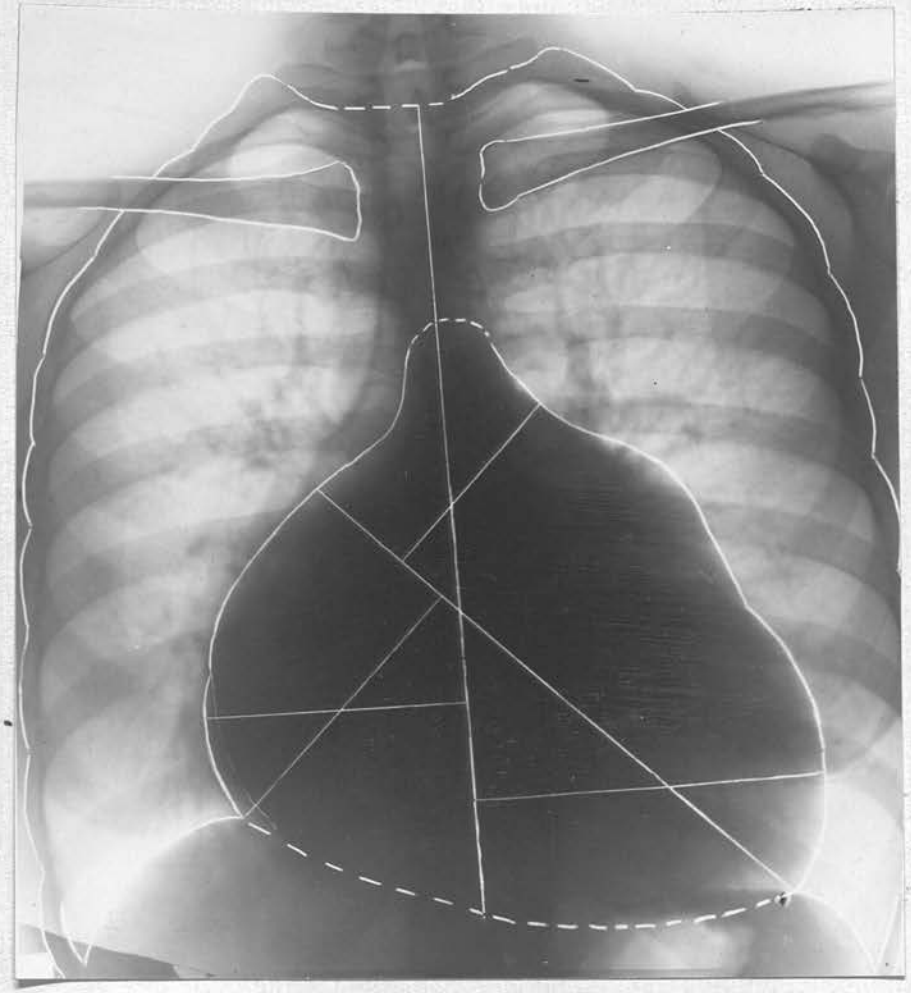
Jan. 28. Rheumatic history. Pericardial adhesions. Mitral disease. Auriclar fibrillation. Apex 11½ to left.
May. 28. On Digitalis. Some pulmonary congestion.
Oct. 28. Condition improved.

CLASS A3.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.	
Jan. 28.	19.0	21.5	265	1.605	= 1.65%
Oct. 28.	19.4	21.1	261	1.58	= 1.65%

Radiograph shows marked enlargement of heart, principally of right heart. The left auricle does not appear to be relatively prominent. Indicates Mitral insufficiency with dilatation of right heart. Percentage area very high. Although area of heart showed decrease with the improvement. The surface area also decreased with loss of weight leaving percentage area unaltered.



Case No.76. Female. 26 yrs.

Dec. 27. Rheumatic history. Auricular fibrillation three to four years duration. Mitral disease.
M.C.L.9 Apex 11 in 5th space.
Case of aneurysmal dilatation of left auricle.

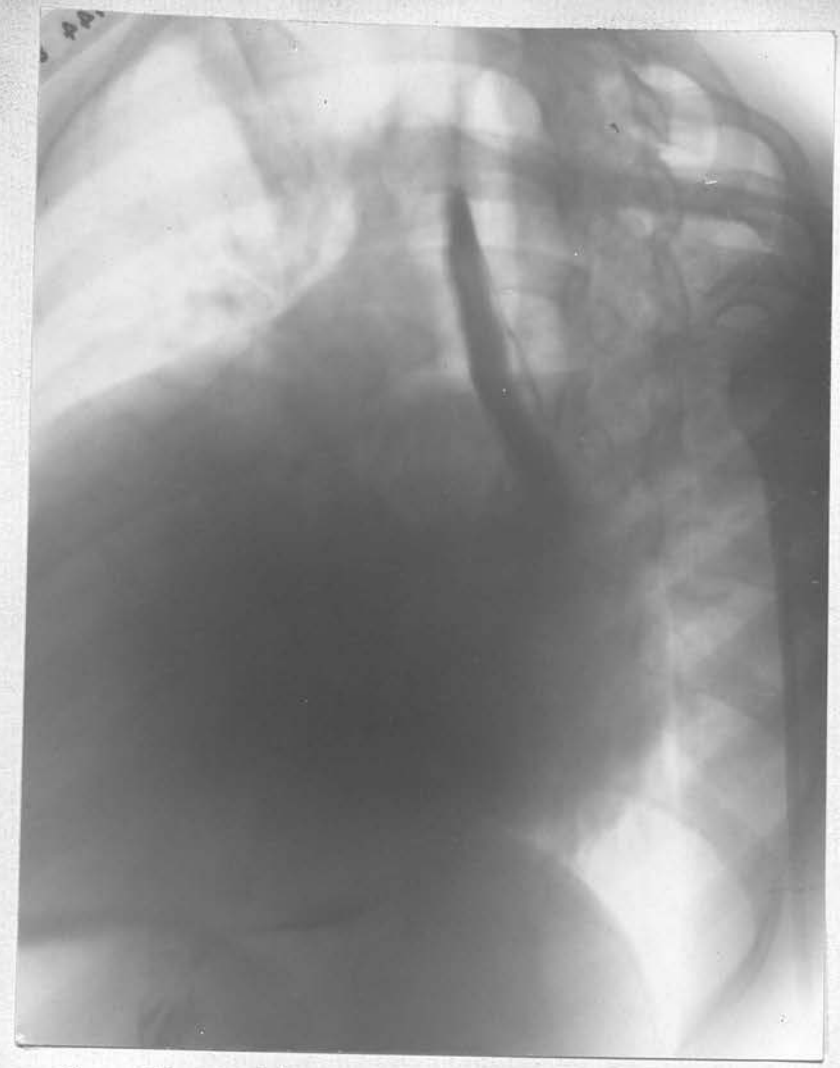
CLASS A3.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 27.	20.1	19.6	256	1.56 = 1.64%

Radiograph shows marked general enlargement of heart. Extreme prominence of left auricle. There is a double shadow in right auricular area apparently the left auricle dilated to right (shown by faint line)

Oblique view shows marked enlargement of auricle posteriorly with displacement of oesophsgus containing some barium.

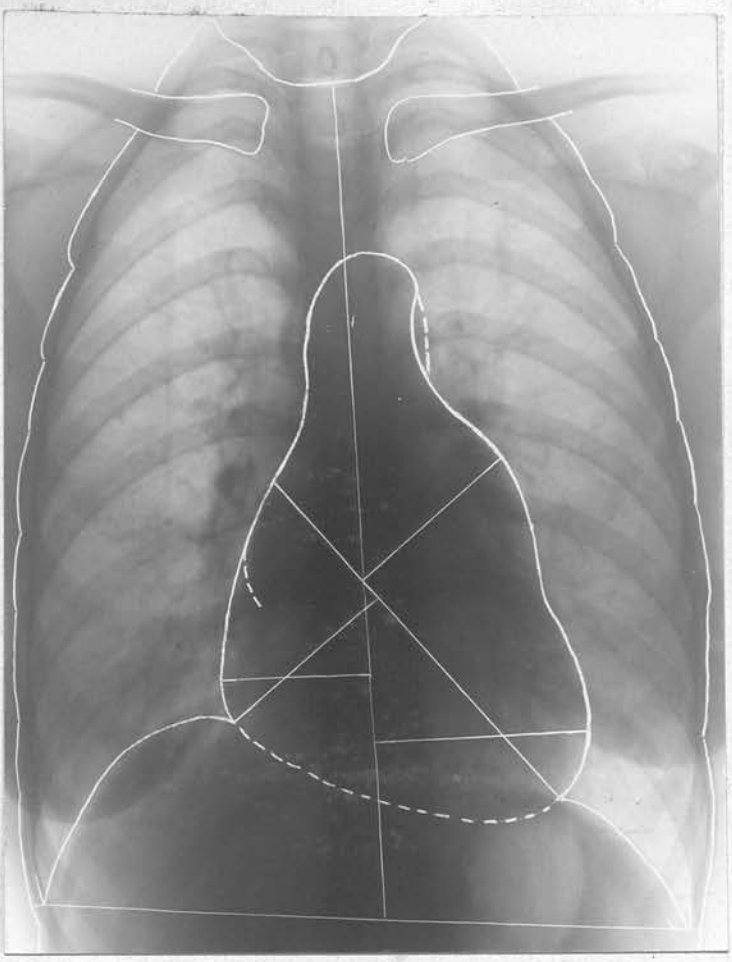


Case No. 76 contd.

The oblique view confirms the dilatation of the left auricle.

Bramwell and Duguid have suggested the term "Aneurysmal Dilatation" for this condition, which they believe to be due to a chronic ischaemic fibrosis of the auricular wall resulting from an infective process. In this case the infection was rheumatism.

The following case (No.103) would appear to be an earlier stage of the same condition. A definite double shadow being seen in the right auricular area, apparently the left auricle dilating to the right. Unfortunately oblique views were not taken in this case, nor were the height nor weight recorded.



Case No.103. Female. 29 yrs.

Dec. 27. Rheumatic carditis. Advanced stenosis. No aortic lesion.
Mar. 29. Advanced mitral stenosis with dilatation of auricle.

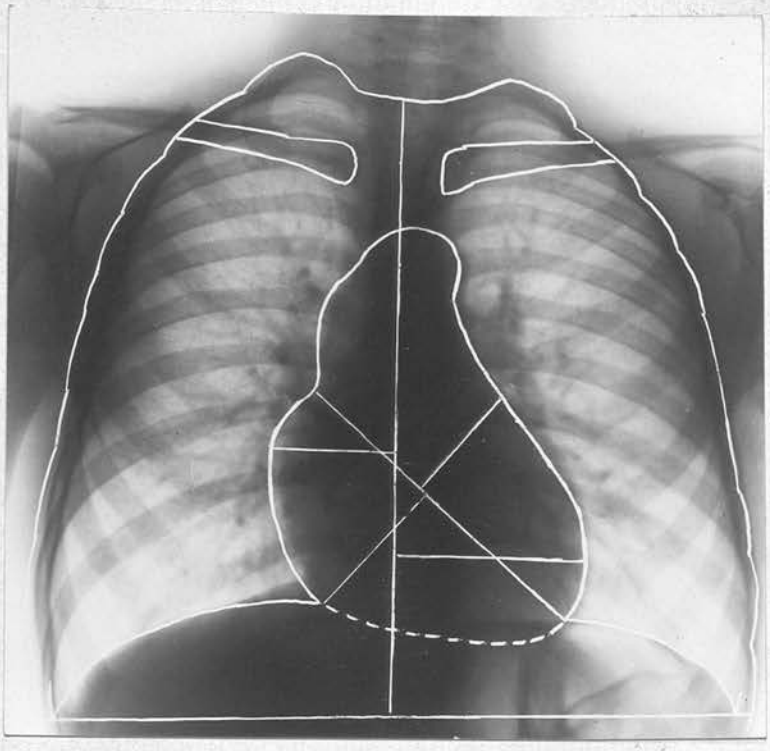
Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 29.	13.8	11.7	139	

Radiograph shows marked dilatation of left auricle. there is a double shadow in upper part part of right auricular area, presumably left auricle dilating to right.

Congenital Heart Diseases.

Six cases of congenital heart disease are shown with a similar classification to the foregoing series. In four of these cases the importance of taking into account the supracardiac area is demonstrated if it is desired to estimate the total increase in the size of the heart above the normal limits. These congenital cases are plotted along with the other cases in the graph at the end of the book.



Case No.17. Male. 8 yrs.

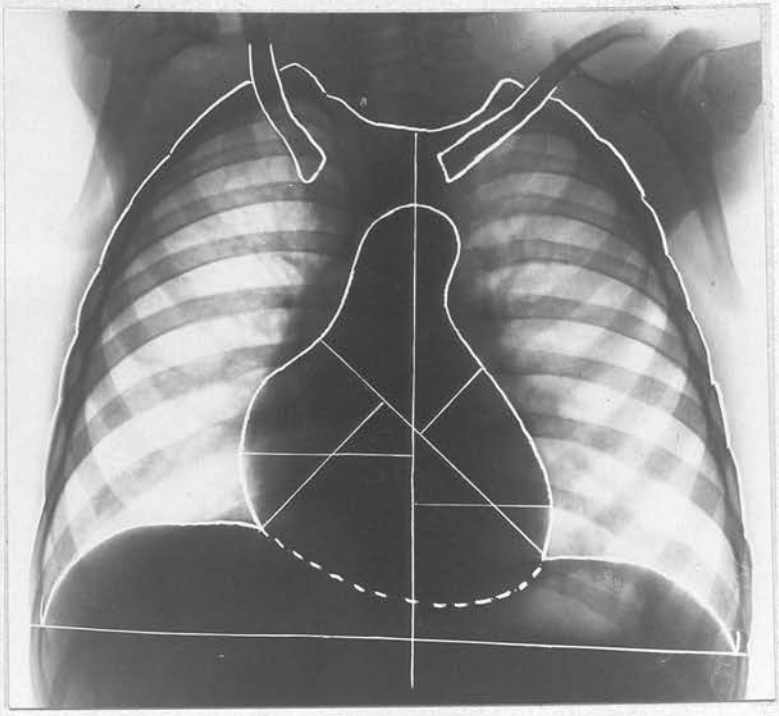
May. 28. Non-rheumatic. Congenital heart disease
Possible patent interventricular septum.
M.C.L.$6\frac{1}{2}$ Apex$7\frac{1}{2}$ 5th rib.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	10.8	10.1	88.5	.88 = 1.05%

Radiograph shows marked enlargement of heart at medio-sternal level, principally of right Auricle. Left ventricular shadow globular confirmatory of perforation of interventricular septum. Percentage area high confirming class A1.



Case No.58. Male. 6 yrs.

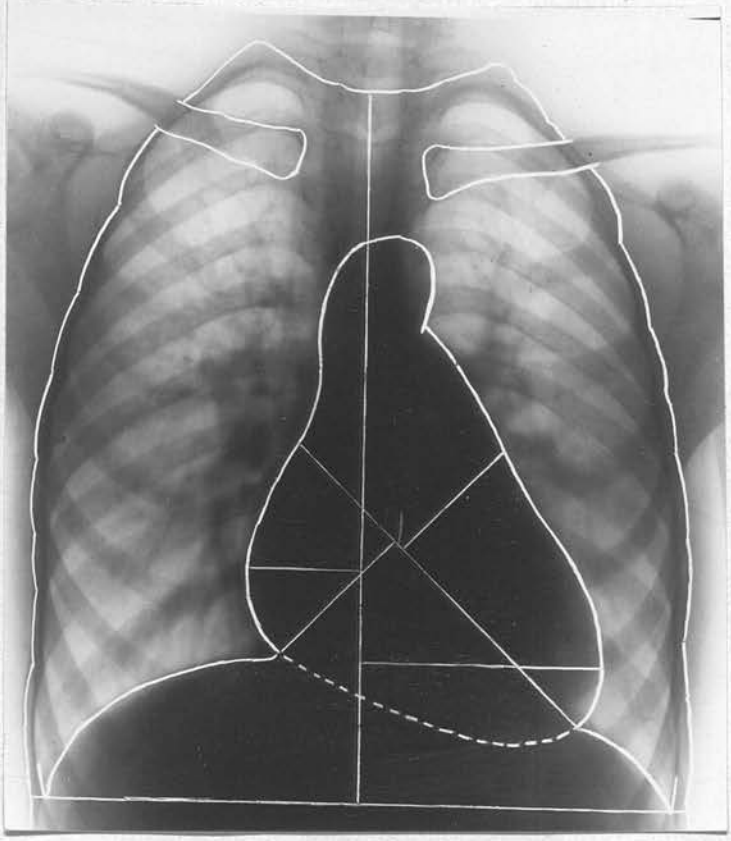
Sept.28. Congenital heart. Possibly patent septum.
M.C.L.6½ Apex 6¾ in 5th space.
Mitral systolic in mitral area and 2nd left space.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Sept.28.	10.3	10.1	84	.895 = .938%

Note globular appearance of heart significant of patent interventricular septum.
Percentage area high.



Case No.70. Male. 12 yrs.

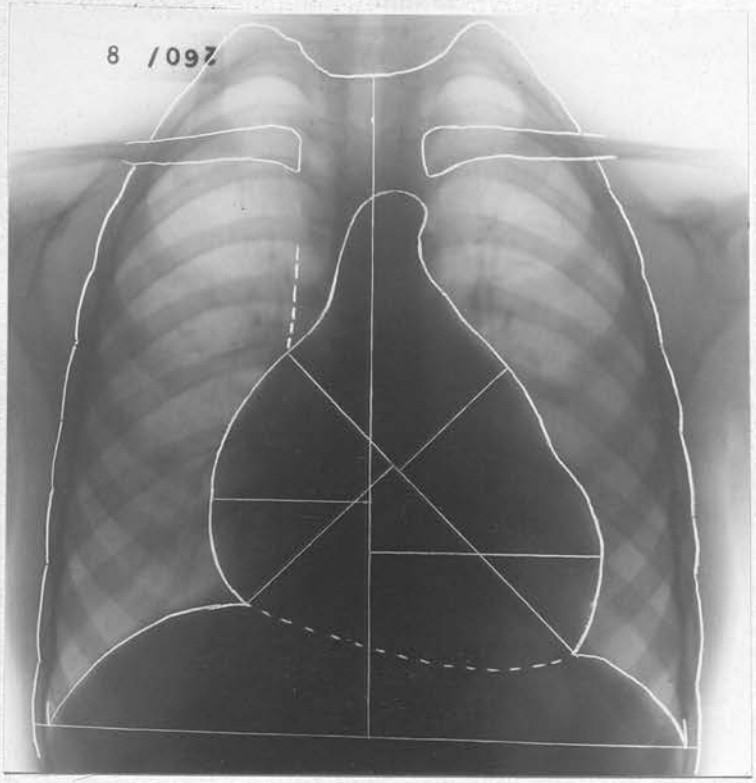
Feb. 29. Congenital heart. Possible patent interventricular septum.
M.C.L.7 Apex 7½ in 5th space.

CLASS A1.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 29.	12.9	11.3	110	1.10 = 1.00%

Radiograph only shows some general enlargement of heart. The medio-sternal shadow being wide. Some cases of slight perforation show few changes in contour of the heart.



Case No.67. Male. 8 yrs.

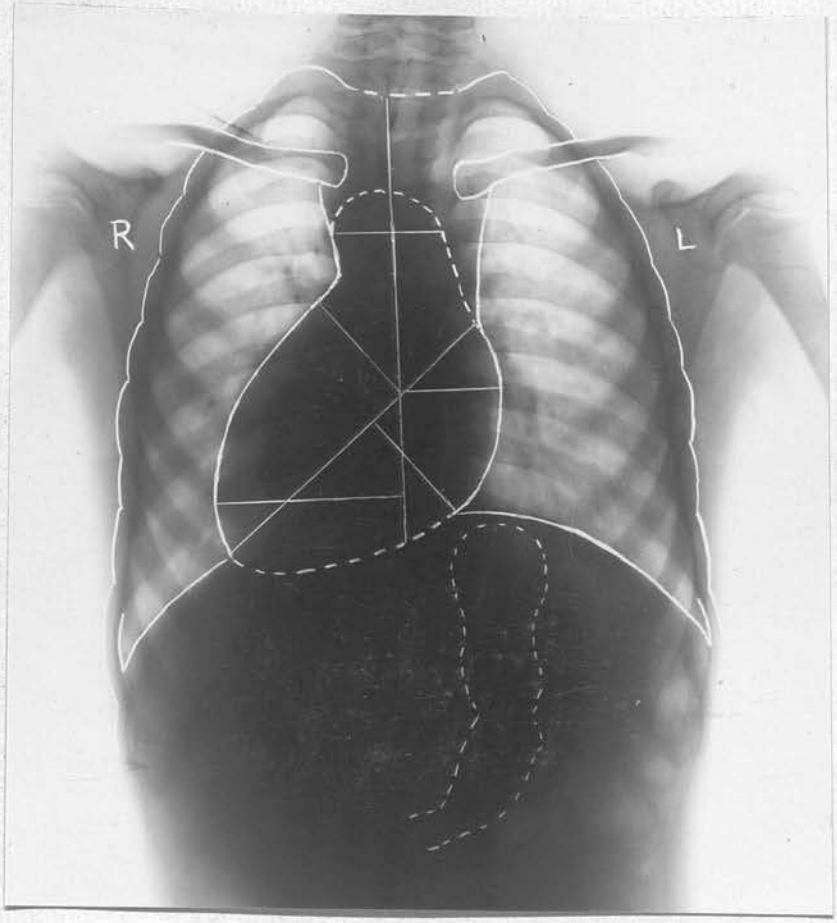
May. 28. Congenital heart disease. Patent ductus arteriosus. Patent interventricular septum.
M.C.L.$7\frac{3}{4}$ Left border $8\frac{1}{2}$

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
May. 28.	13.5	12.7	125	.965 = 1.3%

Radiograph shows typical globular heart of patent interventricular septum. Pulmonary arch not prominent, but patent ductus cannot be excluded Percentage area high.



Case No.77. Male. 7 yrs.

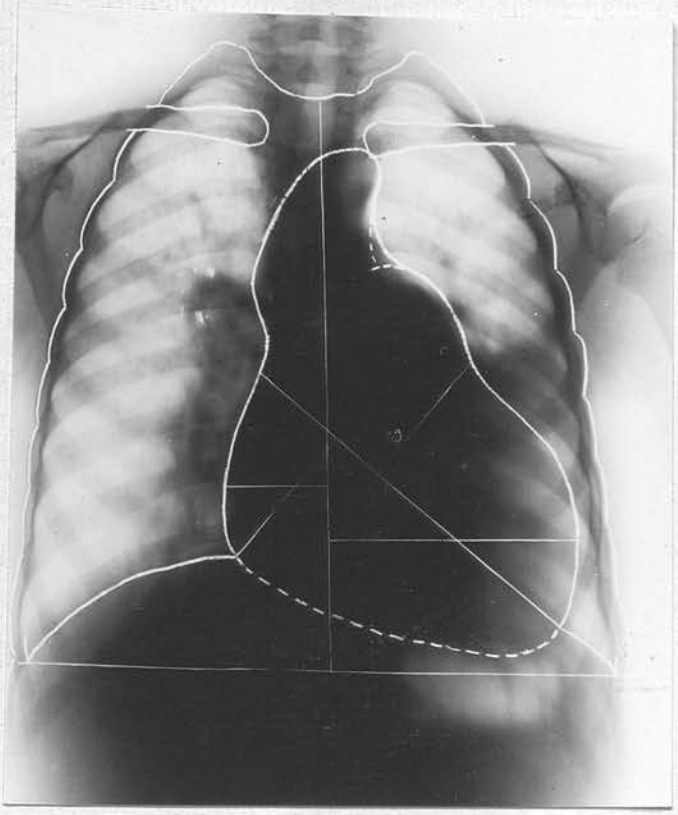
Mar. 28. Congenital pulmonary stenosis with dextrocardia.

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	11.0	9.4	73	.78 = .936%

Case of pure dextrocardia without heterotaxia.
Dotted line outlines barium in stomach.



Case No.35. Male. 6 yrs.

Feb. 28. Congenital heart disease.Patent ductus arteriosus. Possibly patent interventricular septum. Old pneumonia left lung.
M.C.L.5½ Left border 9 in 6th space.

CLASS A2.

Radiographic Measurements.

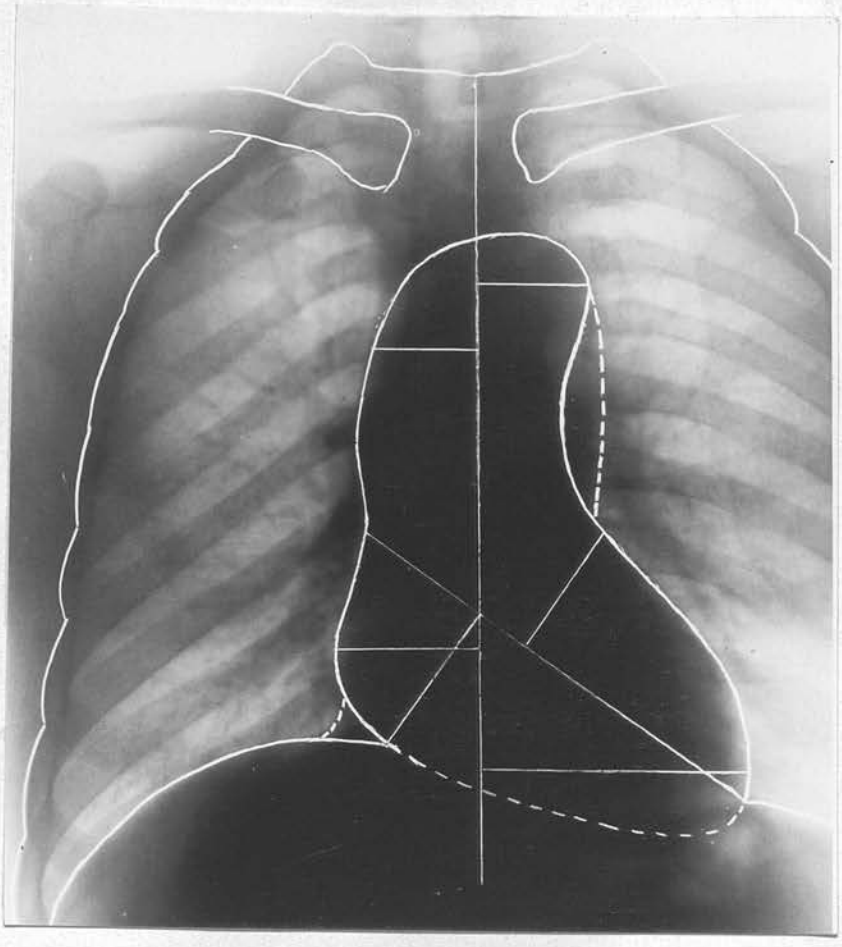
	L.D.	T.D.	H.A.	S.A.
Feb. 28.	12.5	11.7	120	

Radiograph shows typical globular left ventricle suggestive of patent interventricular septum. The pulmonary arc is markedly prominent, and though enlargement of the right heart is not evident,patent ductus arteriosus may exist as well.

Aneurysmal and Arterial Conditions.

The following cases, though not entirely relevant to this investigation are added for the purpose of showing that by including the supracardiac and aortic areas in the measurement of the total size of the heart we may obtain a more appropriate assessment of the degree of cardiac embarrassment in each case.

There are also appended, with a short footnote, some rather interesting cases of aneurysm of the heart and aorta evidencing the importance of the radiological investigation of these conditions.



Case No.66. Male. 43 yrs.

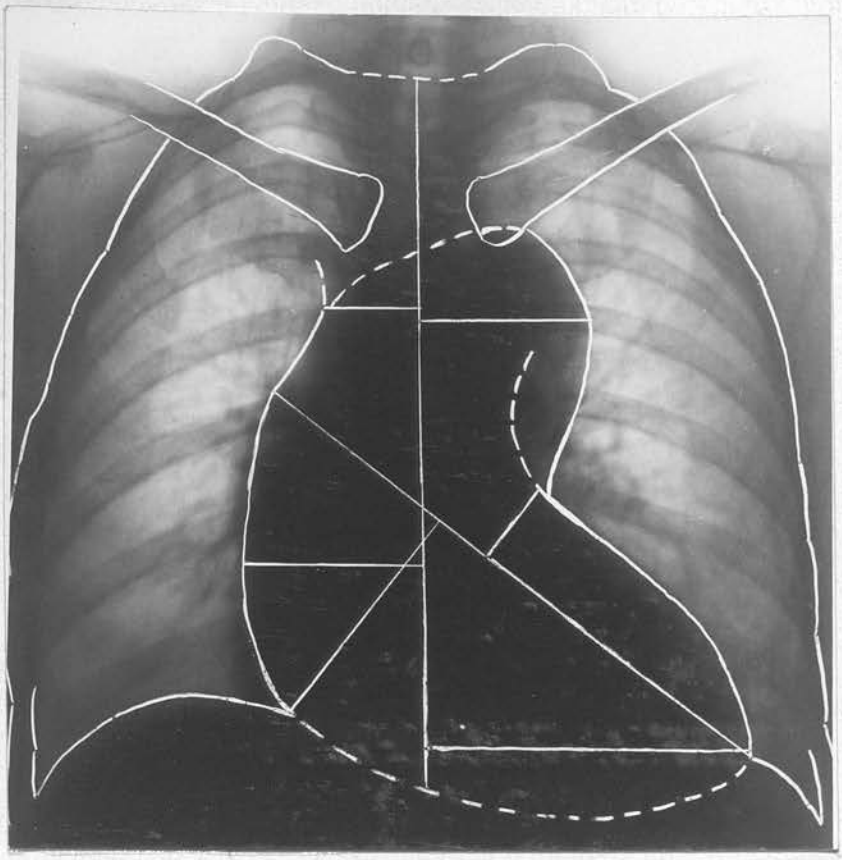
Feb. 29. Non rheumatic. Wassermann negative. Cardiac neurosis with dilatation. No murmurs. Enlarged thyroid.
M.C.L. $9\frac{1}{2}$ Left border $10\frac{1}{2}$

CLASS A1.

Radiograph Measurements.

	L.D.	T.D.	H.A.	S.A.
Feb. 29.	14.8	13.1	159	1.66 = .958%

Radiograph shows diffuse dilatation of ascending and descending aorta. The dilatation in this case is difficult to explain, since the Wassermann was negative, and the patient was neither a renal case nor arterio-sclerotic.



Case No.62. Female. 58 yrs.

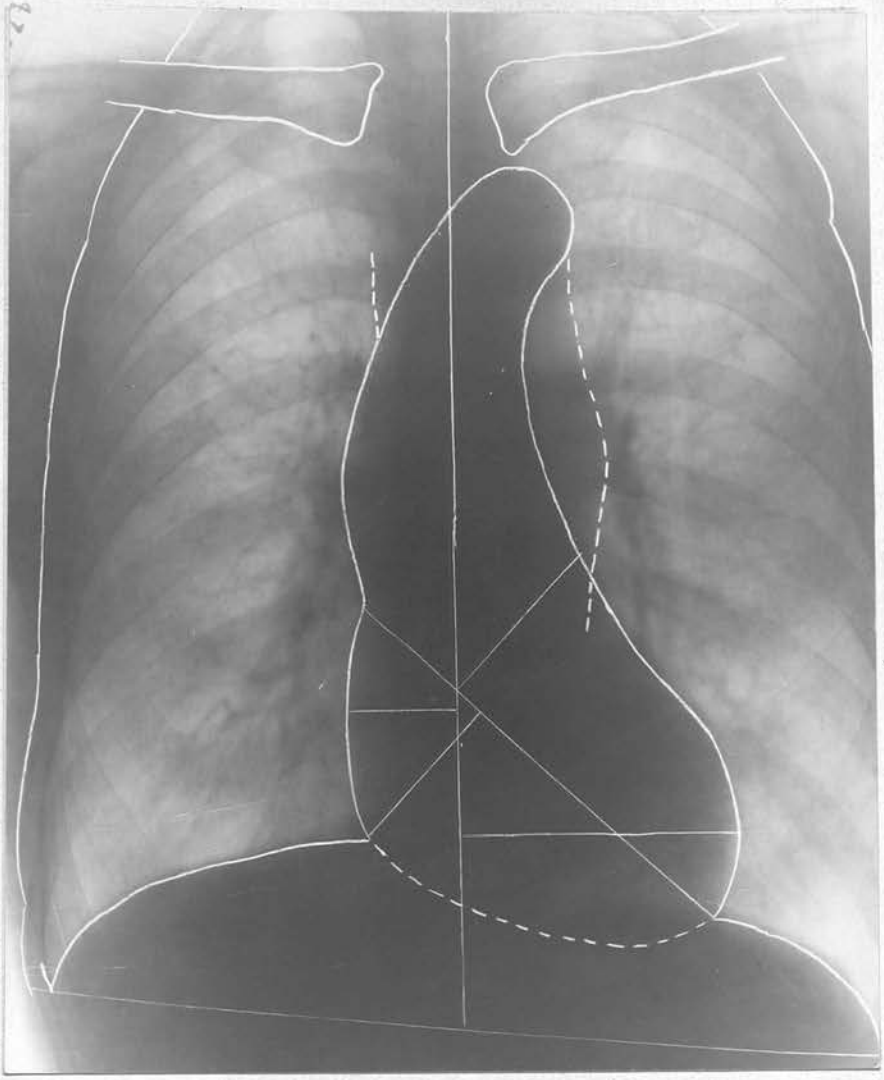
Mar. 28. Marked aortic disease. Specific aortitis with definite regurgitation.
M.C.L.9 Apex 12 in 5th space.

CLASS A2.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Mar. 28.	19.4	16.2	202	1.78 = 1.13%

Radiograph shows marked, and somewhat irregular general dilatation of aorta. Wide supra-cardiac shadow; typical of specific aortitis.
Percentage area high.



Case No.60. Male. 48 yrs.

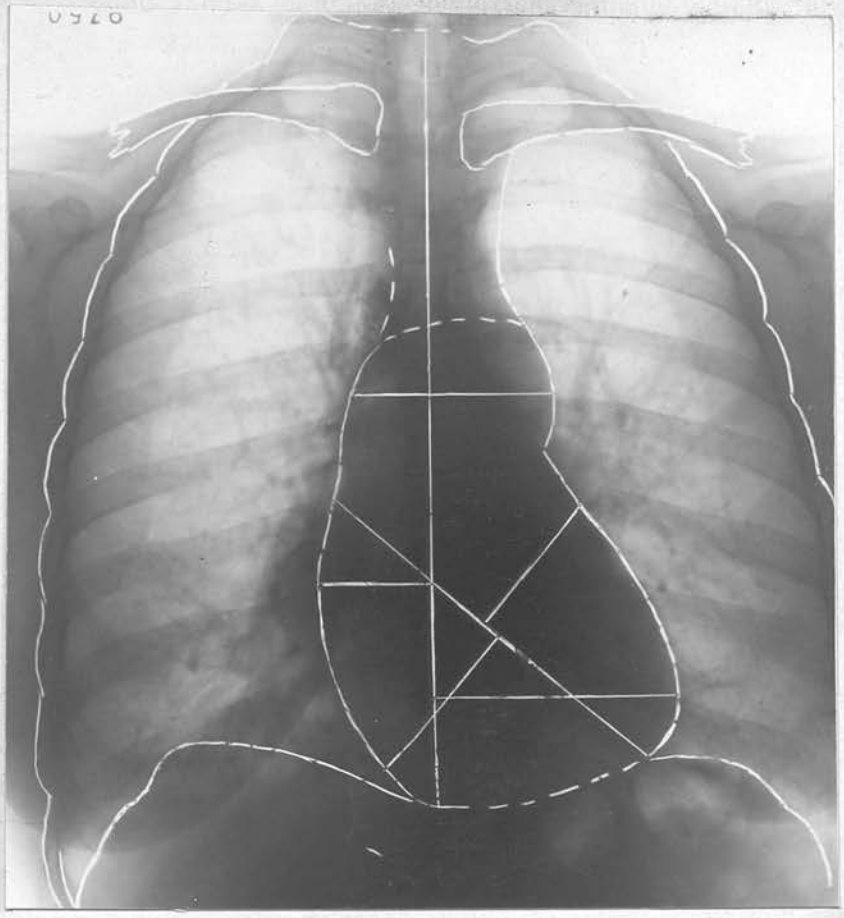
Dec. 28. Specific aortitis--under treatment.

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Dec. 28.	15.0	12.5	192	1.72 = 1.11%

Radiograph shows typically elongated heart of aortic insufficiency. Both the ascending and descending portions of the aorta show fusiform dilatation. The left ventricle shows only slight hypertrophy; the cardio-radiographic index being 13mm.

Percentage area high.



Case No.3. Female. 56 yrs.

Nov. 27. Arterio-sclerotic heart disease.

CLASS

Radiographic Measurements.

	L.D.	T.D.	H.A.	S.A.
Nov. 27.	13.2	11.9	134	

Radiograph shows small hypertrophied left ventricle with marked widening of supra-cardiac shadow and generalised dilatation of aorta.

Body surface area was not recorded.

Case No.105. Male. 50 yrs.

Mar. 28. Locomotor Ataxia and aortic incompetence.

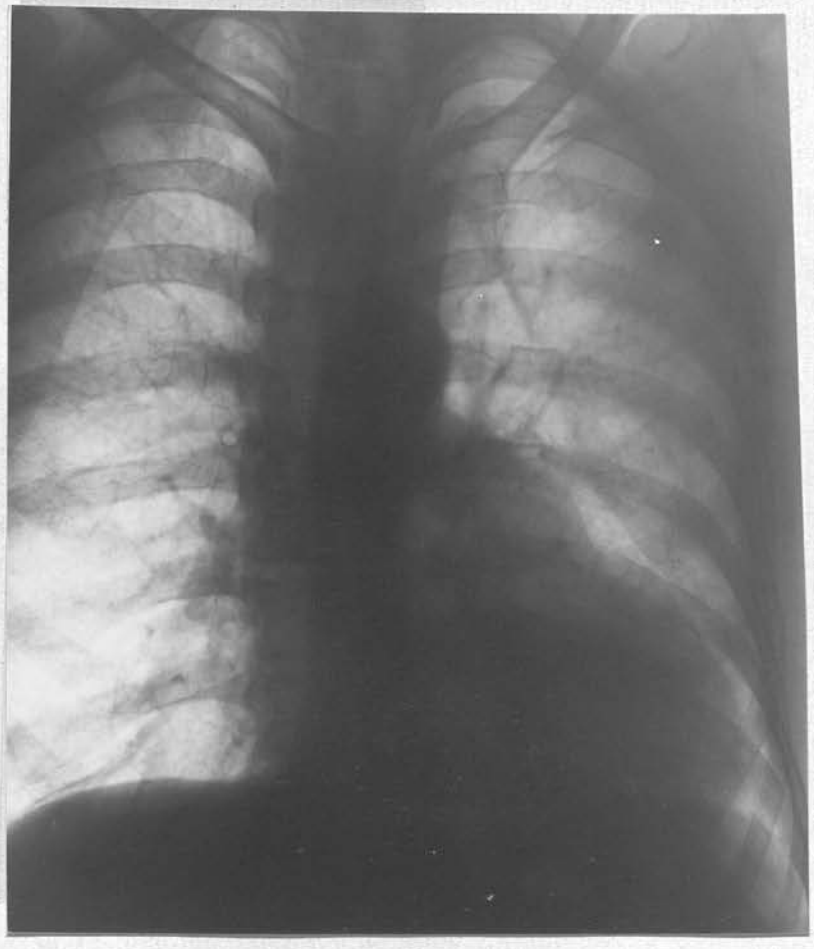
AS patient could not stand erect no tracing was made nor measurements taken. The longitudinal diameter, however, is shown to be greatly elongated, significant of aortic incompetence. There is some evidence of hypertrophy of left ventricle, but no evidence of any concomitant mitral stenosis. The aorta presents a normal outline; the condition therefore, not being of arterial origin.

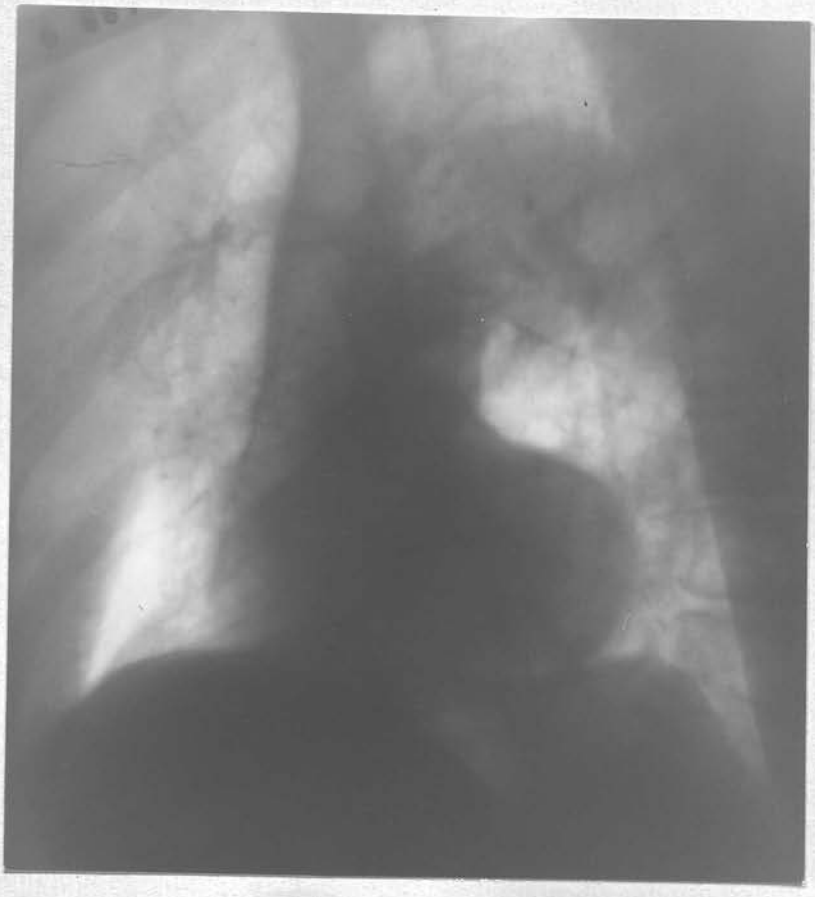
This case illustrates therefore, a condition of pure endocarditic aortic insufficiency in the stage of compensation.

Case of aneurysm of posterior wall
of left ventricle.

(Antero-posterior and oblique views shown overleaf)

The antero-posterior view shows displace-
of heart to left side. On the screen, and to a less-
er degree on the radiograph, a circular area of incr-
eased density was apparent within the shadow of the
left ventricle. On oblique examination it was deter-
mined that the shadow was due entirely to a posterior
enlargement of the left ventricle, the condition
being apparently one of aneurysm of the wall of the
ventricle.

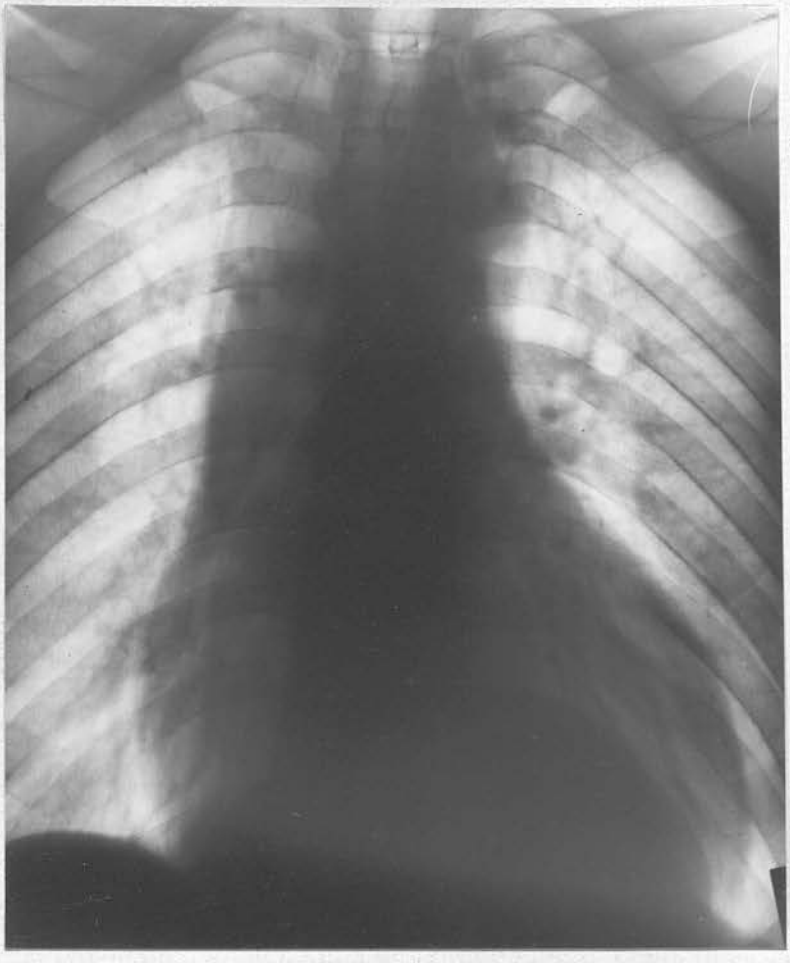


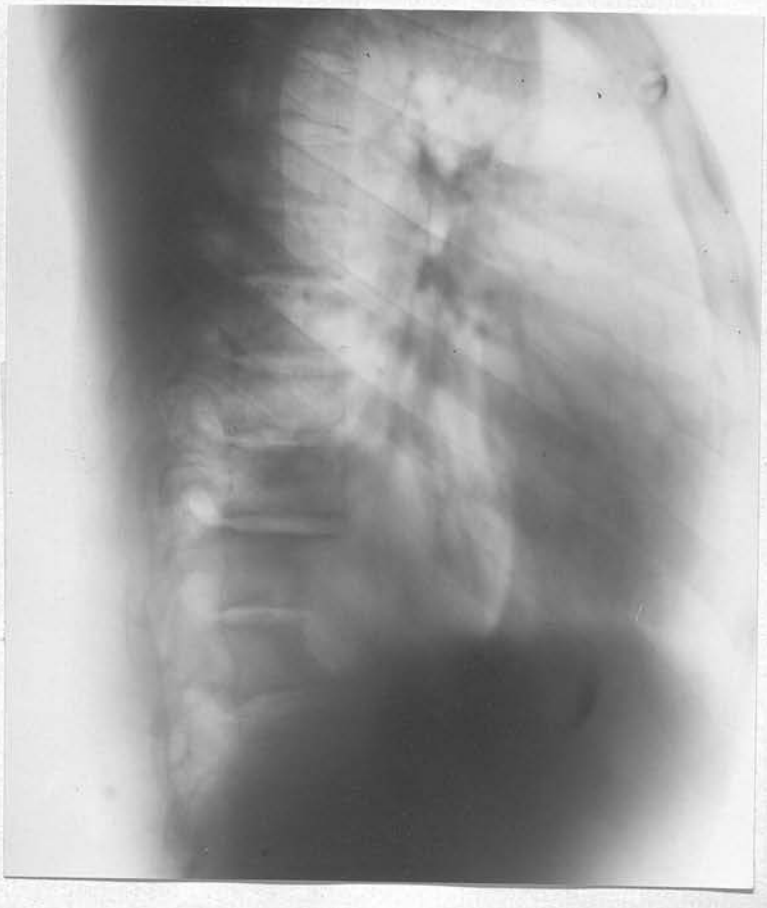


Case of aneurysm of lower portion of descending thoracic aorta.

(Antero-posterior and oblique views shown overleaf)

The antero-posterior view shows the aneurysm as a dense area within the shadow of the left ventricle. The oblique view demonstrating well erosion of eleventh and twelfth thoracic vertebrae.



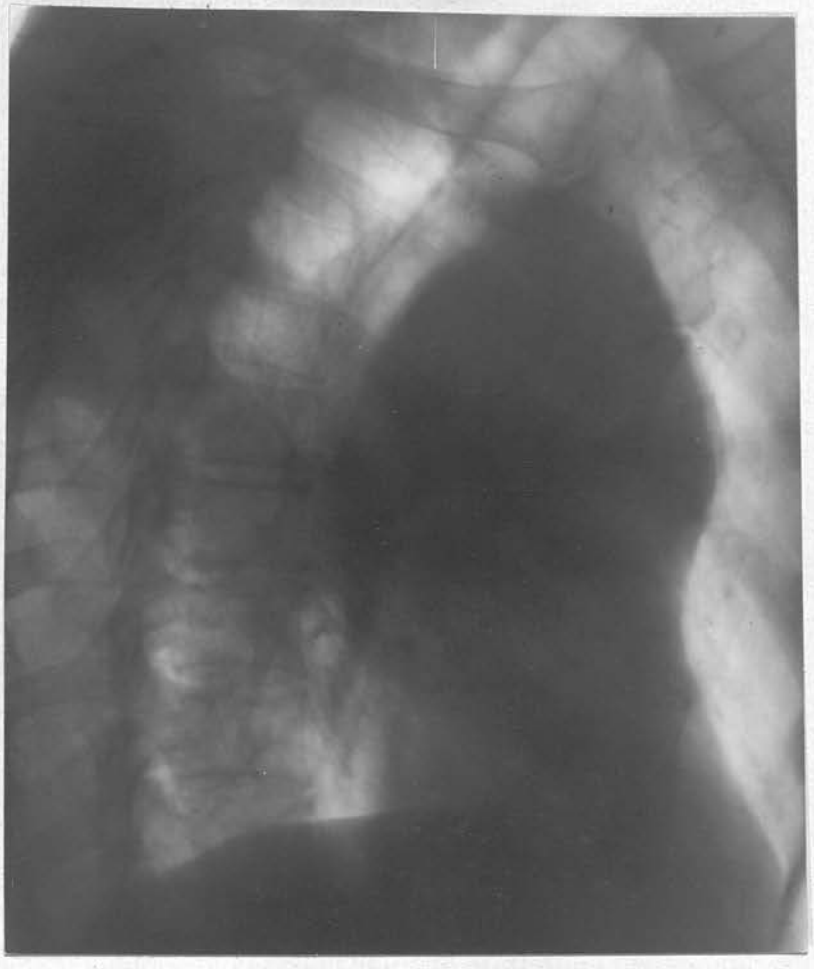


Case No. 27. Male. 59 yrs.

Case of saccular aneurysm of ascending, transverse and descending portions of aorta. The condition was not diagnosed clinically since malignant growth in the mediastinum could not be excluded.

Radiographic and radioscopic examination enabled a positive differential diagnosis to be made.

(Oblique view shown overleaf.)



Case No. 27. (contd.)

Oblique view of aortic aneurysm showing limitation of the shadow of the aneurysm to the outline of the vessel.

Case of saccular aneurysm of transverse and descending portions of aorta showing marked displacement of trachea. The condition was not diagnosed clinically. The faint shadow overlying the border of the left ventricle is difficult to account for, the screen examination excluded an aneurysm of the descending aorta at this level and a condition of the pericardium is suggested, possibly a haemopericardium.

CONCLUSIONS.

1. In a general way the valuable assistance which Radiology offers to the clinician in the investigation of heart conditions is discussed, stress being laid upon the view that the lesser degrees of cardiac enlargement can be infinitely more accurately recorded by Radiography than by any other method.

2. The technique of the examination of the heart by X-Rays, as employed in the Royal Infirmary, Edinburgh, is detailed.

3. Particular attention is drawn to the methods employed in measuring the area of the heart projection as obtained by teleradiography, the writer being of the opinion that if the total cardiac area, including the supracardiac and aortic areas, is measured a more reasonable estimate can be formed of both the major and minor degrees of cardiac enlargement.

4. The question of relating the area of the heart to the individual is discussed and the suggestion formulated that perhaps the most useful relationship is found to exist between the surface area of the heart and the surface area of the body, consideration being made for the age of/

of the individual.

5. Over one hundred cases are presented in a classified series in which this relationship has been worked out in each case. The results are considered to be interesting and in all probability of some value to the clinician, though it is apparent that many more cases must be examined by this method before definite conclusions can be arrived at.

6. Some interesting cardiac conditions are included with notes on each case which demonstrate the value of the X-Ray examination in the differential diagnosis of these conditions.

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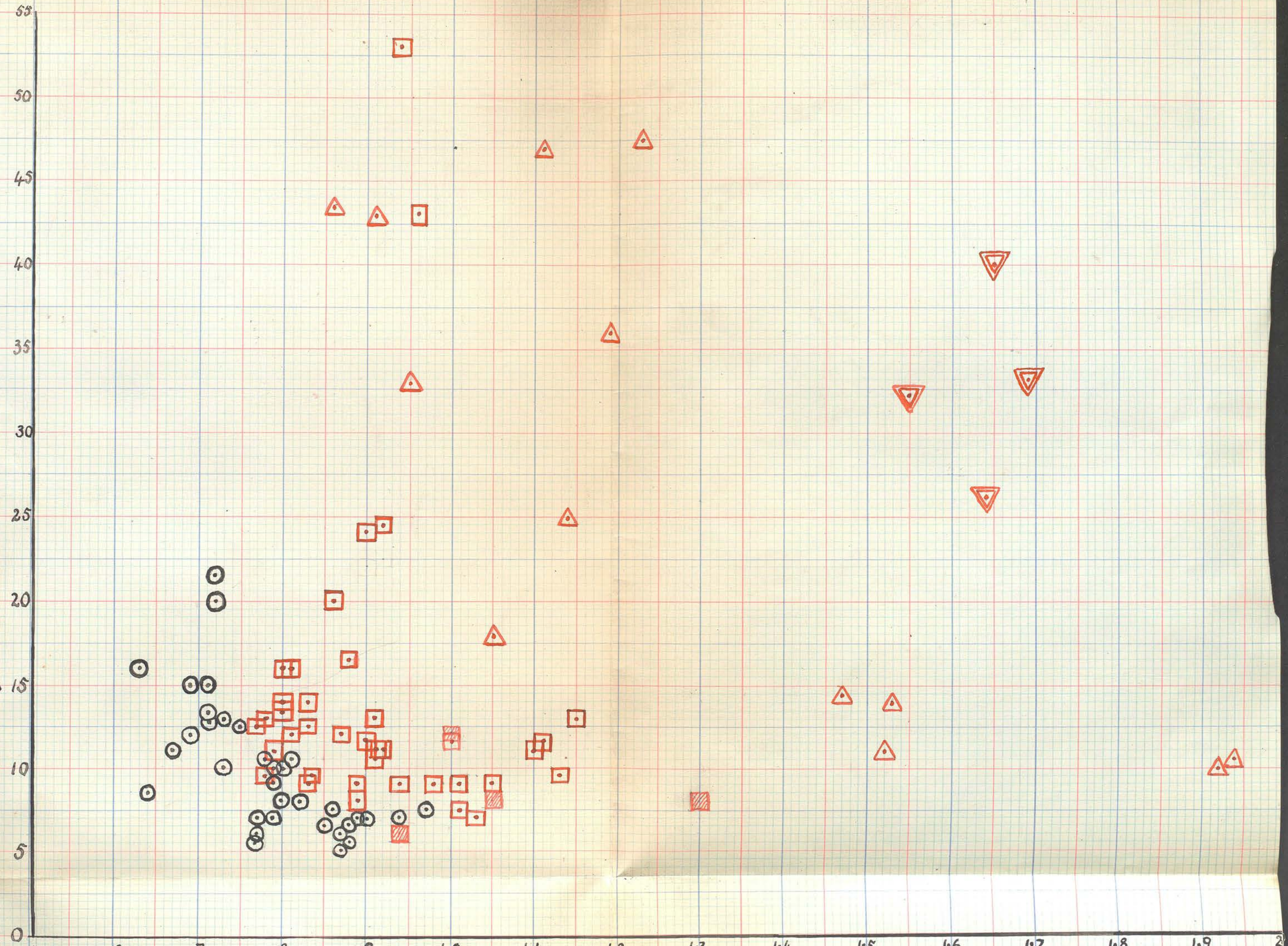
Age in Years.
55
50
45
40
35
30
25
20
15
10
5
0
·5
·6
·7
·8
·9
1·0
1·1
1·2
1·3
1·4
1·5
1·6
1·7
1·8
1·9
Percentage Area of Heart to Body Surface.
⊙ = No organic disease present.
⊡ = Organic disease Class A1.
△ = " " Class A2.
▽ = " " Class A3.
▨ = Congenital heart disease.